

INSPIRED AMATEURS

by
Kevin Guinagh



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KEVIN GUINAGH

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PREFACE

BY ARTHUR E. MORGAN

Chairman of the T.V.A.

THERE would be some consolation in having nine lives, like a cat, if one could live them simultaneously. Yet it would be incomplete consolation at that, for the lives I want to live run into the scores or the hundreds, and nine would be only tantalizing. Whenever some person lives one of the lives I have wanted to live, or does one of the things I have wanted to do, I feel a twinge of jealousy, almost of resentment, that an intriguing and virgin field has been occupied by another. To establish a claim to spiritual respectability I should add that this primitive reaction of envy is more or less counteracted by a feeling of satisfaction that an alluring field is not neglected, but is giving interest and zest to some one.

When Mr. Guinagh informed me that he was writing this book, I had a feeling of envy that so supremely alluring a subject should be preëmpted. Yet this is one of the many fields I am destined to pass by without entering to explore, and so it is a pleasure to stand at the entrance and draw attention to its absorbing interest.

A book which interested and greatly encouraged me as a boy was entitled *Illustrious Shoemakers*. It consisted of short biographies of men who had dared to lay down the shoemaker's last in order to lead the world in some field. It appears that the mending of shoes does not demand the full attention of an active mind,

and so the old-time shoemaker had time to think. I have almost completely forgotten the contents of that book, but I can still recall the sense of freedom and of added courage it gave me. It is not always true, I found, that the shoemaker should stick to his last, and even so humble a calling might be the doorway to significant accomplishment.

Mankind has always paid its highest allegiance to the amateur. The name which has been held in reverence by more men than any other since the birth of the race is that of a carpenter who became an amateur teacher, sociologist, and guide to a way of life. A great body of professionals has grown up who presume to explain and mediate this amateur to the world. But how often has their professionalism cut men off from the great amateur spirit whose name they bear?

Could there be a more perfect example of this professional interference than the contrast between the amateur and the professional spirit toward prayer? The Great Amateur said, "Use not vain repetitions, as the heathen do. . . After this manner therefore pray ye"; and he gave them in the "Lord's Prayer" an example of a spontaneous expression of the spirit. Whereupon the professionals for nearly two thousand years, forgetting the admonition, "use not vain repetitions," have taught the *Paternoster*, and have furnished strings of beads for counting the repetitions.

Not even the creative amateur brings his works into being from nothing. He catches the spirit of what went before, and gives it larger meaning. The Great Amateur was in this sense the fulfillment of the Hebrew prophets, and the greatest and most creative of them were not the professional mumblers of formulas, but

were also amateurs. The prophet Amos is typical. When the professionals, fearing his radical ideas, urged that he go back to his home and earn his bread by the trade of prophecy, he disdained their advice, saying, "I was no prophet, neither was I a prophet's son; but I was an herdsman, and a gatherer of sycamore fruit: And the Lord took me as I followed the flock, and the Lord said unto me, 'Go, prophesy unto my people Israel.'" Amos was a true amateur.

Andrew Carnegie had an idea that throughout America there might be genius burning itself out without opportunity for expression. Perhaps his school reader had contained the lines:

"Full many a gem of purest ray serene
The dark unfathom'd caves of ocean bear;
Full many a flower is born to blush unseen
And waste its sweetness on the desert air."

So he created the Carnegie Institution of Washington to be a clearing house for those ideas which had not found opportunity for expression. I recall, from memory, from the final report of the first president of the institution, a statement to the effect that no such desert flowers or ocean gems had been forthcoming, no "mute inglorious Milton" had been discovered. He stated, if I remember correctly, that no worth-while idea had been presented to the institution which was not the product of long and vigorously disciplined preparation on the part of the person who had achieved it.

I have sometimes wondered whether Mr. Carnegie did not make the mistake of selecting a professional to search for amateurs. Yet there is truth in this retiring

president's statement. To be an amateur does not mean to be unprepared. Get behind the appearance of any great idea or of any great accomplishment, no matter how suddenly it may seem to have arrived, and nearly always we shall find a substantial background of growth and preparation. Often a large part of the preparation of a lifetime is crowded into a few years of very intensive effort.

In other cases there is gradual and steady achievement over a long period; but wherever there is any achievement worth while, either in thought or in action, that accomplishment nearly always is the product of a great total of effort. This is no less true for the amateur than for the professional. In thirty years of varied engineering experience I have not recognized half a dozen new and worth-while engineering suggestions made by persons who lacked substantial training in that field.

Schliemann as a boy dreamed of his excavations. His profession was but an interlude to the expression of his dominant life interests. In my own case, interest in education, as the fundamental process for improving the cultural fabric of society, had an earlier origin and a deeper root than my professional interest in engineering. As Mr. Guinagh so well observes, it sometimes is necessary to be an amateur in order to be free.

Sometimes, as in the case of Henry Ford, or that of Edward Bellamy, the author of *Looking Backward* and of *Equality*, achievement comes from straight thinking about the realities of life rather than from the reading of books or from work in the laboratory. Had Henry Ford been "properly" trained in the axioms of economics, he might never have acted upon those common-sense conclusions on fundamental economics which by

his action have so profoundly changed economic thinking in the last two or three decades. Occasionally what is most needed is not great knowledge, or even keener thinking, but a fresh outlook and freedom from indoctrination. In political life, for instance, the Machiavelian philosophy of shrewd, worldly wise duplicity sometimes appeals strongly, even to very intelligent persons, who enjoy the zest of using mental shrewdness, and have confidence in their superior acumen. The ultimate futility of that philosophy may be clearest to the simple-minded but straight-minded amateur.

Sometimes I dread the results of universal education, especially higher education. We become so indoctrinated with traditional ideas which may not be true, and we become so humble before the imposing prestige of accepted professional opinion, that we lose the power of independent creative thinking. We need a "Society for the Preservation of Ignorance," so that occasionally someone of great mental vitality and directness may look at the world anew and tell us what he sees. But I would have honorable membership in that society confined to men of creative drive and insight.

The impracticability of this suggestion illustrates a profound fact. This great fact is that in administering the affairs of life our choices are not between right ways and wrong ways, but between ways all of which are at least partly wrong. If a man becomes thoroughly familiar with a subject before making his own contribution, he thereby commonly becomes so indoctrinated with accepted ideas that he may lose his own creative originality. The great Leonardo da Vinci, but for his unconscious acceptance of current religious cosmology, might have become the first evolutionary geologist.

That conventional indoctrination blocked the free action of his mind in the presence of suggestive facts.

On the other hand, lack of mastery of what men have thought and achieved leaves one mentally in the childhood of the race, with small chance of summing up all preceding human experience in any field, and then of surpassing it. Years ago while waiting for the railroad train in a southwestern Minnesota town, I spent my spare time in exploring the personalities of the village. Among my discoveries was that of the village printer who was also an inventor. He became very confidential and took me to see a perpetual motion machine he had made. On looking it over I remarked, "Oh, that is an Archimedes screw." Whereupon the inventor replied indignantly, "No, it isn't. I never met that gentleman. This is my own invention."

We forever face this dilemma of either losing our creative originality through being indoctrinated with what other men believe, or of remaining primitive children in our minds because we have not equipped ourselves with the accumulated knowledge of the race. The professional man as a rule must travel the conventional and accepted road of preparation and must submit himself to indoctrination in order to gain professional recognition. The amateur can strive to achieve a new balance of preparation and of freedom from indoctrination. The professionals will bring about the gradual perfection of present methods and, by the use of the scientific method, will sometimes follow the necessary sequence of ideas into new and unexpected worlds. The amateur, free from the necessity of achieving professional standing, will occasionally follow his nose into new and original points of view, and will be one of

the chief sources of new creation and of readjusted emphasis; but he may waste his life over false issues. We need both the amateur and the professional.

One of the most powerful forces for molding our intellectual theories is self-interest. The physicians of America are generally opposed to public medicine. The amateur, who views the situation without self-interest, may have a sounder view. Just at present the foremost presidents of our endowed universities are decrying increased taxation of large fortunes. Unconsciously they speak from professional self-interest. With fewer great fortunes there will be less endowment. Were they living in a world of caterpillars they would deplore that apparent disorganization and loss of effectiveness which accompanies transformation from the caterpillar stage through the chrysalis stage to the mature insect form. Like children who resent giving up present interests at bedtime, men cling to those occupational interest patterns which have given meaning and stability to their lives. Sometimes the amateur is necessary to create a new pattern.

Mr. Guinagh could not, in the course of any single volume, exhaust his subject. He can only open the doors to a most alluring field and bid us explore further for ourselves. Just to indicate how far the subject is from exhaustion, Mr. Guinagh does not mention that prince of amateurs, Leonardo da Vinci. Painter, sculptor, architect, mechanical inventor, unconsciously responsible for the cotton spinning industry, military engineer, geologist, greatest anatomist of his day, psychologist and philosopher, he found the world intriguing at many points.

Nor does Mr. Guinagh more than mention the first

of all American amateurs, Benjamin Franklin. He was printer, writer, diplomat, business man ; it was purely as an amateur that he discovered the identity of lightning and electricity. Observing a seed in a whisk broom in a friend's house, he planted the seed and started the broom corn industry of America. Seeing a sprout on a piece of willow furniture which had been dropped in Dock Creek, in Philadelphia, he planted this sprout and started the willow furniture industry on this side of the water. He founded the University of Pennsylvania and the American Philosophical Society. These are by no means all of his undertakings. He did not shrink from action out of deference to the superior ability of the professional.

The elaborations of science have not closed the door to the amateur. Rather they have opened many new doors. For years, a Mr. Harrison, a shopkeeper on the Kentish coast east of London, collected curious flints along the chalk cliff and made a careful study of them. Since he had neither social status nor professional standing, he was scorned by professional anthropologists. The British Museum would not list his collections. Finally, however, this amateur triumphed. His curious flints are now recognized as man-made implements, and because of his work the recognized age of man in Britain has been extended half a million years.

The real distinction, however, is not between amateurs and professionals, but between minds and personalities that are creative and those that are not. The creative mind takes the wisdom of the past as food to be digested, assimilated and made over into its own living being ; the non-creative mind takes the accepted cultural inheritance as ready-made clothing to be worn according

to the authentic style. The ideal man would be he who could take all the past has to offer, using it as the source of material for his own creative activities, without being indoctrinated or mastered or warped, while being enlarged and taught. We sometimes see men with the driving vigor and stubborn critical discrimination which enables them to be informed but not indoctrinated. Wherever that quality appears the distinction between amateur and professional begins to fade.

The routine administration of our world, and a large proportion of the most brilliant and creative contributions to human progress, will be the work of professionals. Yet creative minds are not made to order and do not result from training, and so professionals are forever getting into deep ruts and losing the broader view. It will continue to be the work of the amateur, wherever he may unexpectedly emerge, to see life fresh and new, to refuse to deaden creative power by conformity, and to make those profound readjustments of emphasis and attention which men must achieve if they are to keep on the main highway of survival and progress, and are to escape the blind paths of provincialism and over-specialization which have diverted so many peoples and so many species, and led them to extinction. The amateur must help save our civilization from being only the digging ground for future archeologists, and he can have a good time in fulfilling that function. Mr. Guinagh has done a service in introducing us to him.

I

THE SHOEMAKER AND HIS LAST

I

THE SHOEMAKER AND HIS LAST

WE often hear the cautious advice that the shoemaker should stick to his last. Those who like to have their doctrines fortified by ancient authority should glory in this proverb, for the Greek painter Apelles is credited with being its author. The origin of the proverb is told by the Elder Pliny. The painter Apelles, in his unusual desire to hear honest criticism, hid himself behind one of his pictures. A shoemaker who chanced to pass that way observed that the shoes he had painted had one latch less than the approved style; the artist quickly corrected the error. When the shoemaker later noted that his suggestions had been heeded, he began to criticise the leg that wore the shoe. It was then that the artist's head appeared from behind the picture to remind the shoemaker that he should give no opinion beyond the shoe. This advice, originally spoken to a shoemaker, has now a general application and may be directed by mere artisans to artists.

Despite the age of this proverb—let the shoemaker stick to his last—I am for letting the shoemaker look up from his last if he chooses. The fact that this proverb has been quoted for centuries need not disturb us. Antiquity is the most fruitful mother of error, wrote Arnobius, a Christian writer of the third century. Let the shoemaker be heard if he has a message. Perhaps in his mind are germinal ideas that may blossom into inspiration, if allowed the sun and air. He may become an inspired amateur in some art or science, and

the world may beat a path to his door, as in the case of the man of mouse-trap fame. Although I tell the shoemaker that he may look up from his last, I do not go the whole way with Herr Emil Ludwig in maintaining that the inspired amateur beats the professional every time. His statement is not without rhetorical exaggeration.

If the matter were debated, the discussion would turn upon the definition of inspiration. Those who have read something of the disputes on the inspiration of the Bible will remember that men speak of the inspiration of Shakespeare and the inspiration of the Holy Ghost. Herr Ludwig might cogently contend, if challenged, that not every amateur is inspired, but that those who are inspired of the Holy Spirit, as it were, often reach above and beyond men who have spent their whole lives over these same problems.

Our grandfathers never missed the opportunity of showing the Latin derivation of a word whenever it had any bearing on a subject under discussion. Today one offers such information with considerable reluctance, for readers often class such observations under the heading of pedantry. But everybody who has begun the study of Latin knows that the word *amateur* is derived from *amator*, meaning a lover. An amateur in the sense in which I shall use the word is one who pursues some interest because he loves it. His zeal is not inspired by his lust for money. His daily bread does not depend on the success or the orthodoxy of his work. Money may come to him in the pursuit of his interest. This, if he be human, he will hardly refuse, but he places his rewards in the satisfaction of his curiosity, the joy of possession, the sense of achievement.

That man will be regarded as an amateur who becomes absorbed in some subject in which he has never been professionally trained, but who develops an interest alien to his education and occupation.

We are not concerned with that distinction between the amateur and professional which exists in athletic circles whereby a man becomes professional when he has received payment for even a part of a single game. By this Midas-touch of gold the man who may be a tyro of tyros is suddenly by some strange alchemy transmuted into a professional.

Nor are we concerned with those amateurs who are uninspired. The world is full to overflowing with such men. These are the dilettanti, the devotees of hobbies, who pursue a subject intermittently. It is not my purpose to rail at such interests. You may be one of that vast host which finds recreation in collecting stamps, first editions, or butterflies. Far be it from me to ridicule the interest that makes your life worth living, that refreshes your mind for the battle of the ensuing day. As the machine lessens the hours of employment, educators are constantly emphasizing the importance of finding some absorbing activity to aid men in spending their leisure with profit and pleasure. You may be taking lessons on the violin; you need no man to spring to your defence, though you may later be thankful for a little fatherly advice. It is in defence of you that G. K. Chesterton wrote, in his usual paradoxical manner, about the importance of doing things badly.

These pages are not written in justification of the rights of the amateur who is uninspired. He needs no apologist. I am interested in certain amateurs who rose out of the class of dilettanti to a height where they

overshadowed many professionals. I have no interest in proving that these inspired amateurs beat the professionals every time; in fact, I have no definite thesis to prove. I am simply interested in sketching, because they are interesting, the lives of men who distinguished themselves in a field in which they were not specifically trained.

The inspired amateur approaches a subject with certain advantages. In the first place he is not controlled by the groove of the past called tradition. There is a healthy attitude toward tradition, but there is also a deadening technique resulting from the adoration of one's predecessors which finds expression in the smug exposition beginning: "This is the way we have always done it."

Often the amateur knows nothing about the history of the subject which he is assaulting and for this reason he may not realize in his hardihood that he is rushing into a situation where angels fear to tread. The kingdom of ideas suffers violence sometimes, and the violent bear it away. If the beginner knew at the outset all the volumes written on the subject before he began to interest himself in it, he would be discouraged at the mountain of reading that lay in his path and probably would retreat. For those who finally succeed it may be said that their blissful ignorance was an asset.

In this connection it is interesting to recall a conversation that once took place between the two great French scientists, Fabre, "The Insects' Homer," and Pasteur, the chemist. The latter, although the subject was entirely out of his field, was appointed by the French government to rehabilitate the silkworm industry. He knew nothing about the work and did not conceal his

ignorance when given the appointment. Whereupon, the official who commissioned him said that he would therefore be in a better position to conquer the disease, since he would have no ideas on the subject except those that would come as the result of his own observations. Pasteur came to consult Fabre. The latter has left us an account of this interview, which was a spur to his own researches, although he did not like Pasteur's haughtiness toward him :

A few words were exchanged concerning the prevailing evil ; then, without further preamble :

"I wanted to see some cocoons," said my visitor ; "I have never seen any ; I know them only by name. Could you get me some ?"

"Nothing simpler. My landlord is himself a dealer in cocoons, and he lives across the road. If you'll be good enough to wait a moment, I will bring you what you want."

A few long strides and I had reached my neighbor's house, where I stuffed my pockets with cocoons. On my return I offered them to the scientist. He took one, turned it over and over in his fingers ; curiously he examined it, as we should some singular object which had come from the other end of the world. He shook it against his ear.

"It rattles !" he said, quite surprised. "There is something inside !"

"Why, yes !"

"But what ?"

"The chrysalis."

"What's that, the chrysalis ?"

"I mean the sort of mummy into which the caterpillar turns before it becomes a moth."

"And in every cocoon there is one of those things ?"

"Of course ; it's to protect the chrysalis that the caterpillar spins."

"Ah !"

And without more ado, the cocoons went into the pocket

of the scientist, who was to inform himself at leisure concerning this great novelty, the chrysalis. . . The ancient gymnasts presented themselves naked for the contest. This ingenious thinker, who was to fight the plague of the silk-worm nurseries, had also hastened to battle wholly naked: that is, devoid of the simplest notions of the insect he was to save from danger. I was astounded; more I was filled with wonder.

A second advantage of the inspired amateur is that he has no obligation to be sound. He may make the most exasperating statements, suggest the most radical solutions, and the world will not even take time out to correct him. But those who aspire to being authorities in a field must exercise caution in their statements, for the word may be passed around that the professor is unsound. This cry "unsound, unsound" will go up from the ranks of his colleagues and will produce as much isolation for the radical as the shout of "unclean, unclean" did for the leper of medieval days. Novel ideas in a professional mind may mean the loss of prestige and bread. The ambitious young professional has a tendency to learn the methods invoked by other members of his profession, adopt a safe style, and avoid a figure of speech as if it were poison.

Another advantage of the inspired amateur lies in the fact that, pursuing a subject solely for itself and for the interest he has in it, he often expends more energy on it than the man who makes his living thereby. Many men are not interested in the work at which they earn their bread. They suffer it but do not love it. The inspired amateur, on the contrary, does not keep one eye on the clock to determine how long he must stay at his office, desk, or laboratory before he is free. The

amateur, the lover, never feels that time passes slowly. The hours this wooer spends with his love speed far too quickly for him. His private study is his recreation. This intense interest brings with it that concentration without which few men have ever written their names in bronze.

It must not be inferred that professional men as a class are not interested in their work, nor that there are not many professional men who are inspired. The outstanding work in any major field of study has been effected by men who were regularly disciplined by formal instruction and who pursued a routine of labor from day to day. At the same time it cannot be denied that there are some members in every profession who are uninspired.

If anyone discerns anything derogatory to the professional in these pages, it must be remembered that these gibes are intended for the uninspired professional. Such a man often possesses the form but not the content, the shadow but not the substance. It is he who sets about with solemn air to expound the obvious. When he finds a detail has been incorrectly stated, he may dilate on the discovery out of all proportion to its significance. It cannot be denied that trifles make perfection, but to overemphasize a trifling flaw betrays a lack of that prime quality of a balanced mind, a sense of perspective.

Your uninspired professional is often selfish. He is interested in maintaining the security of his position and to this end he will make appeals to narrow loyalties, will insist on the letter of the law, and demand those little courtesies which seem to come most frequently when they are unsought. Instead of considering a statement in itself, he is prone to inquire for the credentials

of the man who made it. If he learns that the idea comes from an amateur, he may observe that the new-comer has injected himself into a controversy that has been traditionally regarded as delicate. To him it is a personal insult if an amateur ventures to question the theories that have received the blessing of the leaders in the field. If he is hotly pursued, he rushes inside the stockade of authority.

One of his sharpest weapons is the query : "How long have you been at this subject?" He likes to talk of how long he has studied or practised, wishing at the same time to have it inferred that the years spent at a study infallibly make men wise. Perhaps he has been doing the same thing over and over for years, without the least effort at improvement. With all his service, he may never have risen superior to the performance of his fifth year. An uninspired professional, then, may resemble the blind horse walking the treadmill, vainly believing that he is covering vast sweeps of territory when, in reality, he has never left the spot where he began.

But again let it be made clear that these faults belong to the uninspired professional. Whoever thinks he reads between the lines of these pages a covert attack on professionals in general will probably be forced to admit, if closely questioned, that he has been reading too many detective stories. When one praises an amateur he does not by the very fact belittle the professional. These sketches are written in the hope that they may entertain a little and instruct a little, but certainly not with the intention of supporting any theory maintaining the unqualified superiority of the amateur over the professional.

II

PREACHER CHEMIST

JOSEPH PRIESTLEY

II

PREACHER CHEMIST

JOSEPH PRIESTLEY

TO BE a sickly boy in the eighteenth century was not always a disadvantage in life. Strong sons were early put to some hard work while their weaker brother was often forced to find a way of making his living with his brain. The frail lad knew that the only way he could win the respect of physically strong men was by showing the world what he could do in the realm of ideas.

Little Joseph Priestley, sitting in a far corner of the living-room in his aunt's home at Leeds, was just such a boy. He was doing his best to read, but who could keep his mind on a book when those ministers over there in front of the fire were discussing, as usual, the torments of the damned? Always they kept at those terrifying themes, hell, its eternity, the pains awaiting those predestined to punishment even before they were born. The boy was tired. He wanted to go to bed, but who could sleep with those frightful pictures before his mind? Besides, his aunt had told him that one of the ministers was going to speak to him a little later. When the questions of theology were finished, his aunt began :

"I wanted to talk to you, doctor, about Joseph's education. His mother, poor thing, died in the hard winter of '39 after giving birth to her sixth child in six years. My brother is having a hard time with the other children. I suppose he will be marrying soon again. Joseph is twelve now and a good boy. He has never given me cause to rebuke him. He reads all day long,

and it is my firm belief, doctor, that he is destined to be a minister."

The doctor turned to the boy in the corner of the room and asked him if he desired to serve God.

Young Priestley tried to express satisfaction at such a prospect, but when he began to talk he stuttered uncontrollably. "I—I—It would p—p—p-lease me very much."

The aunt and the doctor quietly discussed the boy. Joseph knew what they were saying in spite of the minister's attempt to lower his voice. "The boy is sickly . . . he stutters . . . either of these is an obstacle to a successful career in the ministry."

In spite of his handicaps, he was given the opportunity to study. By the time he was sixteen, he had a fair knowledge of the learned languages, and without a master had assaulted French, Italian, and German. His ambition to be a minister seemed foiled by illness when his health suddenly improved. After studying in a seminary supported by the Dissenters, he found himself in his twenty-second year a minister earnestly preaching the word of God. The parish he was given was not a rich one. His salary was only thirty pounds a year, a mere pittance to be sure, but what could a stuttering minister expect? Priestley held on in his lonely parish. He was hardly popular. He was too troubled with questions of belief to be bowing and smiling and chatting, the approved technique of winning lay approval. As a consolation in his trouble, he had taken up the study of the scriptures. While toiling over ancient texts, the conviction grew within him that he could not honestly subscribe in his soul to some of the doctrines he was supposed to profess and expound in the pulpit.

Disturbed by his biblical studies, he glutted an appetite for facts on science. For the education of the public and the benefit of his purse he offered a series of twelve lectures on *The Use of a New and Correct Globe of the Earth*. His talks were scarcely appreciated—there were only ten listeners at the last session—and when he counted the collection, he had just enough to pay for the materials he had bought to illustrate the lectures. He shrugged his shoulders, realizing that at least he had added to his scientific equipment. Unhappy preacher, he dreamed quite pardonably of a richer benefice, but his next call was to a still smaller parish.

There was a great advantage in this smaller charge. Here he could open a school. He now became a most exacting schoolmaster, teaching thirty boys and half a dozen young ladies from seven in the morning to four in the afternoon. How he resisted any suggestion they made in favor of an occasional extra holiday! Didn't he himself instruct private students even after four o'clock? People soon began to say that he was a better schoolman than a minister. His work was so successful in the classroom that it opened for him an appointment as tutor of languages in Warrington Academy.

While he was at the academy, he always managed to spend a month of each year in London. It was on one such vacation that he met the philosopher from Philadelphia who had performed that notable experiment with the kite and key. Franklin immediately recognized a strain of genius in the young man and suggested that he write a history of electricity. The American was willing to furnish the books for the necessary research. With these spurs to his ambition—the praise and encouragement of a great man almost twice his age

—he rushed to the task. Within a year he had finished the volume, which brought him election to the Royal Society.

With such honors in his thirties he should have been happy. But he had taken on new responsibilities. He had married. The cry of the financially embarrassed pedagogue has been heard in every age, and Priestley raised his voice to swell the chorus. How could he rear a rapidly increasing family on his salary? He had scientific fame, but did that butter bread? Now he remembered that his duty in life was to preach the word of God, a calling that would pay much better. When he received an invitation to a congregation of liberal views at Leeds, he accepted. Here he threw himself into the writing of controversial pamphlets by which he soon offended many within and without his church.

Even the clerical mind must relax. Priestley sought rest from the ardors of doing God's work by performing those experiments which have made his name immortal in the annals of pneumatic chemistry. His preparation was limited to a few lectures given by a Doctor Turner of Liverpool, the author of that beautiful bit of rationalization pointing out that, although England had lost the American colonies, she had been compensated for her loss by the planet Uranus, then recently discovered by Herschel. But these lectures were of little help to Priestley. He did not know the "approved" methods of his day. And we are glad that he didn't. As he himself pointed out :

I have often thought that upon the whole, this circumstance was no disadvantage to me ; as in this situation I was led to devise an apparatus, and processes of my own, adapted to my peculiar views. Whereas, if I had been previously

accustomed to the usual chemical processes, I should not have so easily thought of any other; and without new modes of operation I should hardly have discovered anything materially new.

The pious parishioners in Leeds began to gossip when they saw their new minister entering the brewery near his house. What in the world could he be doing there? Rumor had it that his interest was not in the beer but in the gas that bubbled to the top of the liquid in the fermenting vats. A likely story! But wasn't it just a bit undignified for a minister to be found so frequently in a brewery? If they had followed him they would have seen a sight that was already causing employees of the brewery to fear for his sanity. They watched him as he bent hour after hour over the fermenting vats of beer. In one hand he held a lighted candle, in the other chips of wood which he lighted from time to time and placed near the surface of the liquid. The flame was always extinguished by the bubbles of gas.

"What strange air is this!" he thought. "If we had enough of this we might extinguish great fires. . . How marvelous are the ways of the Creator!"

When he moved to a new neighborhood he found it inconvenient to be returning constantly to the brewery. It was then that he invented the pneumatic trough—for which alone he would be known—by which he collected quantities of this gas. He mixed some of this new gas with water and agitated it. What a pleasant drink it made! In fact it was as pleasant to taste as expensive seltzer water. Thus was carbon dioxide discovered, without which the soda fountain would be a very flat institution indeed.

"The father of soda water" received a great deal of

fame from his experiment. Men rushed to do him honor. The Copley medal was conferred on him by the Royal Society. The College of Physicians viewed the experiment. That learned body recommended that the navy use it to combat the horrors of the scurvy, from which sailors suffered in those days. But this was just another in the long list of incorrect prescriptions for the scurvy that doctors had given. A seaman was later to show the physicians how to prevent the sea scurvy.

Patrons have a way of stepping forward to offer aid when the days of need are past. The minister's fame attracted Lord Shelburne, who urged Priestley to be his secretary. The salary was splendid—over eight times what he had received in his first parish—and there was a house to boot. Priestley, however, was not fascinated by the arrangement. His lordship had a nasty way of ending friendships, but in this case there was to be a generous allowance if they separated. The offer was too good to be passed by.

Once established as his lordship's secretary, he had an abundance of time, and he spent much of it in writing religious tracts. Whenever he needed recreation he went to his crude laboratory.

A burning-glass furnished him as much amusement as it does a small boy. He directed the sun's rays on many different substances and collected the resulting "air." When he focused the rays of the sun upon a red powder, the oxide of mercury, it gave off a new kind of air with which he was not acquainted. By chance a lighted candle was at hand. He put it into the gas. It flared up. He inserted a wire, previously brought to a red heat; it took on an added brightness.

If this were ordinary air he knew that the candle would have been quickly suffocated, the wire would not have appeared to come to life.

His theory about this new air was quickly formed. He would learnedly call it dephlogisticated air, that is, air minus phlogiston. And what was phlogiston? It was a chemical myth that had been handed down to Priestley's era. By it men attempted to explain the mystery of fire. It was that mysterious, invisible substance that escaped in combustion. When coal was burned, the advocates of this theory explained, little of the weight of it remained in the ashes, and this was caused by the fact that coal contained so much phlogiston. Opponents pointed out that metals when heated increased in weight. But the chemist, who was bound to save his theory, was not stopped by any such objection. He explained that in such cases there existed negative phlogiston. Priestley liked this old theory, and he held on to it to his dying day. He could deny that there was a spiritual principle in man, he could assert that man was nothing but matter, but throw over phlogiston, never!

For months he thought about this new air. Then one day he wondered if it might not be better than common air. That could be determined quickly if a mouse were put into a vessel containing some of it. When he appeared in the kitchen with a trap his wife asked:

"Why, Joseph, whatever are you about now? I thought you were at work on your *Harmony of the Gospels*. Really I think it is more in keeping with the dignity of your calling than wasting your time with mouse traps."

"I'll do no more on the Harmony today. I need some mice. A little experiment, my dear."

Returning with his captive mice to his laboratory, he put the mouth of a vessel containing this new air upside down in water. Then he passed a mouse through the water into the vessel, carefully placing it on a little deck so that it would not drown.

"When I have imprisoned full-sized mice in ordinary air," he reasoned, "they have died in about fifteen minutes. This may be better than ordinary air. At any rate I'll observe carefully and play the flute meanwhile. . . The flute is an admirable instrument, the solace of many an hour that would otherwise be very dull. Moreover, it is easy to play. I think I must speak a word for it some day in one of my papers."

Fifteen minutes passed. Other mice in ordinary air had been unconscious in that length of time. This one was still active. The flute was put aside. In a half hour the mouse became sluggish. In any case, it lived twice as long in this new air as others did in common air. But when he removed the wet mouse from his prison and placed it over near the grate, it quickly revived.

"If this air is better than common air," he mused, "it will do me no harm to breathe in a little of it myself." He inhaled some of the gas through a tube. Not only was his new gas colorless and odorless, but it was tasteless as well. The effect upon his lungs was exhilarating. "Perhaps my air may be of help to those suffering from lung trouble," he thought.

Priestley would hardly be surprised, if he returned from his grave today, to find thousands of people who attribute their recovery from pneumonia to the use of

the oxygen tent. This experiment was made on March 8, 1775, a red letter day in the history of science, for on that day this preacher-chemist saw something of the practical value of the oxygen that he had discovered some seven months before.

While Doctor Priestley remained with his patron, he made many other noteworthy chemical discoveries. Meanwhile, he continued to make contributions to religious speculation. During these years he became convinced of a doctrine—most startling for a minister—that man is entirely material and that his only hope of immortality is in the resurrection. This from a minister who could believe in the myth of phlogiston! The press heaped violent criticism upon his head, terming him little more than an atheist. Soon ill luck, which had forgotten to plague him for a time, returned. He and his patron quarrelled. Shelburne had recently remarried and might be supposed to have less need of a companion.

When he sought to find a place for Priestley in Ireland, the doctor reminded his lordship of the contract by which he was to receive an annuity, in case his services would no longer be desired. Just at this time, a liberal congregation called him to Birmingham. Though for a period of ten years he gave an example of honest thinking and decent living, still he was the devil incarnate to many. He was happy in his seventh year of his sojourn in Birmingham. It was then that he wrote his autobiography, the story of a happy man whose bliss was in his breast. Indeed, he seems to have forgotten his troubles when he wrote:

I esteem it a singular happiness to have lived in an age and country, in which I have been at full liberty both to

investigate, and by preaching and writing to propagate, religious truth ; that though the freedom I have used for this purpose was for some time disadvantageous to me, it was not long so, and that my present situation is such that I can with the greatest openness urge whatever appears to me to be the truth of the gospel, not only without giving the least offense, but with the entire approbation of those with whom I am particularly connected.

Little did he realize when he wrote these words that his greatest trials lay before him. He had applauded the success of the French Revolution and had been made a citizen of the French Republic, in appreciation of the propaganda he had spread in England in behalf of civil liberty. This served to increase his unpopularity with the rank and file of the English people. Not only had he deserted God but he was dishonoring his king as well.

Priestley was friendly with a small group of Birmingham liberals, who planned to hold a dinner and drink a temperate toast on the second anniversary of the fall of that hated prison, the Bastille. The city was seething with rage. A handbill had suggested that the wholesale activity of the guillotine in France would soon be witnessed in England. About the hour set for the banquet, an angry crowd began to collect. It was plain that there would be trouble.

Someone suggested that they burn down the church where Priestley assisted on Sundays. They did—for God and king. The mob, “of many hands but no head,” was mad by this time. The cry went up, “Burn Priestley’s house.” The doctor had not gone to the banquet. He had spent the evening at home, playing backgammon with his wife. Into the room rushed a

breathless man who cried, "Flee for your life: the mob has burned the old and the new meeting-houses. They are headed this way! They will surely kill you, doctor! You have only a moment."

"God have mercy on us!" cried his wife. "Here's your cloak, Joseph."

"This is a false alarm. It can't be true. Impossible!"

Once in the street, he knew that his informer was right. The sound of tumult was close at hand. "One can never be sure in this life," he said to his wife as they rode away from their home. "These poor people are doing a great wrong and some day they will be sorry. I had thought the cause of liberty was making some progress. I only hope that they will not destroy my papers and philosophical instruments. . . . Father, forgive them—they know not what they do."

The leaders of the crowd cursed on finding that their prey had escaped. A few gave chase but to no purpose. To satisfy their fury, they dumped his scientific instruments and his library into the street. Then they wrecked the house. Since there was no Priestley to burn, they burned his effigy instead. Little did they know that he was close enough to hear the rioters demolishing his home.

For three days and three nights the mob raged. The trials that followed were a sham, though three of the rioters were executed. Said King George in grandiose manner:

Though I cannot but feel better pleased that Priestley is the sufferer for the doctrines he and his party have instilled, and that the people see them in their true light, yet I cannot approve of their having employed such atrocious means of showing their discontent.

Escaping to London in disguise, he soon discovered that the members of the Royal Society, who respected his scientific work, were fair-weather friends. They avoided him now in his religious and political difficulties. It took courage to be identified with a man who had been denounced by Gibbon, the historian, and Burke, the statesman. Priestley knew there was no hope for him in his native land. He looked toward America, whither his sons had gone. America, a land of freedom, would welcome him.

Philadelphia, then the capital of the United States, received him with great enthusiasm because of his scientific and political reputation. But it was his desire to preach rational Christianity in the new world. This was the one thing that Americans were not interested in hearing, especially when the doctor's voice was weak and his teeth gone. Ministers looked askance at this new heretic who had created such a furore across the sea. He settled with his sons in Northumberland, one hundred and twenty-five miles from Philadelphia, a journey of five days in those times. Later an opportunity to teach at the University of Pennsylvania was open to him, but poor health, dogging his steps from youth, forced him to decline the offer. He lived on for about ten years, experimenting and prophesying the future of world events with the help of three-month old newspapers and the Bible.

Though Priestley was a great observer, he was weak in drawing conclusions from what he brought to light. Early in his scientific studies, he had adopted the theory of phlogiston, and through his life he expounded this idea with the fervor of a fanatic. When he was dying, he took his lance in hand to fight his last battle for this

theory. He himself had unearthed the information that had destroyed this myth, for he had performed his experiment with the oxide of mercury for the French scientist Lavoisier, who used it to upset this theory of the difficult name. His last work was *The Theory of Phlogiston Established*. This, he hoped, would bolster up his scientific reputation, which, in turn, would interest men in his religious convictions and ultimately lead them to God. "If a scientist like Priestley can be a Christian believer, so can I," was the reasoning he expected. He wanted his work as a theologian to be recognized. "It is in this light chiefly," he wrote, "that I regard it. How insignificant are all subjects compared to those which relate to religion."

His life was a tragedy, as life has often been for men who advanced too far ahead of their times. A century after Priestley fled from Birmingham before the mob's rage, the grandchildren of his persecutors saw his monument unveiled and heard Thomas Huxley sound his praises. The city had repented of its blunder, but those who should have witnessed this triumph were beyond the reach of that humiliation, being long in their graves. Nor will the injustice done a man who should have been treated with respect in view of his honest purpose and spotless life give any modern fanatic pause. Bigots are always burning in the flesh or in effigy those who disagree with them. The pathetic irony of it all is that they will never know the scorn in which they are held when succeeding generations rise up to condemn their prejudices.

III
THE COUNT AND HIS BEGGARS
BENJAMIN THOMPSON

“He was strong, but untrained, and his language was not always such as a truly disciplined man of science would employ.” — *John Tyndall*.

III

THE COUNT AND HIS BEGGARS

BENJAMIN THOMPSON

IN THE days when our republic was in its infancy, there were numerous inspired amateurs abroad in the United States. The opportunities of formal training were scanty, but in spite of this barrier men of native energy and intelligence made use of books, the common man's university, and often attained distinction in a field in which they were neither trained nor regularly employed. Many of the wealthy who could give their sons an education more thorough than any available in the states were sent across the sea to the mother country to acquire that polish which could not be obtained on this side of the water. But men of originality and force might be neither close enough to an institution of higher learning nor wealthy enough to attend its sessions if they were. When such men were intellectually curious, they often pursued a subject with an originality which their thinking might not have manifested, had they been trained in the tradition of the schools.

One immediately thinks in this connection of Benjamin Franklin, who distinguished himself in a variety of fields. With scanty formal training, ending when he was ten years old, he so improved his opportunities in private study that he was highly honored by his contemporaries and is even more so today. By profession a printer, he attained distinction in science, diplomacy and literature. In the field of electricity, he was an inspired amateur, fortunate in his notable experiment

wherein he identified lightning and electricity. We have already seen in the case of Priestley that he was the inspiration of a history of electricity which brought its writer a name in science and membership in the Royal Society.

There is a contemporary of Benjamin Franklin whose career in many respects parallels his, though his fame does not approach Franklin's. That man was Benjamin Thompson, later Count Rumford. Both were born in the British Colony of Massachusetts, Franklin at Boston and Thompson at North Woburn, towns only twelve miles apart. In youth both were poor, ambitious and to a great extent self-educated, though Thompson went for a short period to the lectures of a professor of natural philosophy at Harvard. In spite of the fact that they had many friends in common, they never met, possibly because Franklin was so many years Thompson's senior.

Thompson was early apprenticed to an importer of merchandise. He seems not to have been overmuch interested in the work, but kept objects of mechanical interest handy to occupy his mind when business was slack. When increasing difficulties with England threatened the importing trade, he was forced to look for employment in another field. Like many another great man he taught school—but not for long. So unromantic an occupation could not hold a restless disposition like his for any extended time. The widow of Colonel Benjamin Rolfe fell in love with this handsome young teacher of nineteen and, if we may believe his own ungallant account of the matter, he suffered himself to be married to a woman fourteen years his senior. But the schoolmaster knew there were com-

pensations. The widow had means and a social position, and to a young man of his temper, believing himself destined for great enterprises, considerations of this nature were not to be scorned.

Although Benjamin Thompson was of humble origin, he had that mysterious trait of personality which attracted people far above his station. He seems to have won friends of influence easily; in consequence, he made many enemies. When he was a young man of twenty, Governor Wentworth of New Hampshire caught sight of him on horseback and was so struck with his appearance that he sought his acquaintance. Thompson impressed the governor, and before long, in spite of the young man's absolute ignorance of military training and discipline, he was made a major over the heads of many veteran officers in 1772.

Being close to the governor's ear, he suggested the surveying of the White Mountains, and in this the governor not only concurred but expressed himself as desirous of taking part in the work personally. Meanwhile, experienced soldiers in His Majesty's service uttered deep curses against this upstart, whose commanding figure on a charger was his sole title to the rank of major. Opposition soon arose among American patriots, too. Accused of being unsympathetic to the cause of colonial liberty, he was brought before the vigilantes, but nothing could be definitely proved against him. Meanwhile, he stoutly maintained his innocence. At the outbreak of the revolution when he was twenty-two, he fled from persecution to England, leaving behind his wife and infant daughter. With him he carried despatches from General Gage to Lord Germain, Secretary of State.

Once in England, he was rewarded for his loyalty to the king. Later as a lieutenant colonel, he saw service in South Carolina and Long Island. When peace came, he desired to be sent to the West Indies, but instead, upon returning to England, he was discharged with a generous pension. At the time there was a rumor in military circles to the effect that the Turks and Austrians would soon be at war. A soldier of fortune, he decided to offer his services to the Austrians. While en route to Vienna, he took part in a military review at Strassburg. Once again his striking figure on horseback attracted attention. The duke made his acquaintance and gave him letters to his uncle, the Elector of Bavaria.

The elector liked this handsome foreigner. He understood so much about gunpowder and the making of cannons. Since Austria was not going to fight the Turk, would he not enter the elector's service and settle in Munich? Would he accept the dignity of Count of the Holy Roman Empire? Certainly. He would call himself Count Rumford—after the place where his wife's estate was located. Of course, King George's permission had to be obtained before Thompson could enter the elector's service, for he was a subject of His Majesty. The king not only approved but expressed his pleasure by knighting him.

Count Rumford was aware that his new position was not an empty title. Wherever he turned, shocking disorder was to be seen. The army was wretchedly clad, poorly fed, and therefore dissatisfied and undisciplined. But now he was Minister of War and it was his duty to improve the pay and comfort of the soldiers.

It was his feeling that a peace-time army must be kept

busy—even at projects that were non-military. Soon soldiers who had lately been loafers were employed in a public works program, making and repairing highways, draining marshes, repairing the banks of rivers. To encourage industry each soldier was given a small piece of land to cultivate. Excellent seeds were supplied. Rumford was especially interested in promoting the planting of potatoes. When the soldiers returned to their homes, they took with them this new interest in agriculture. The soldiers, their children and even peasants attended the barrack schools where supplies were free. With his characteristic economy he saw to it that the used paper was saved for the making of cartridges.

If the army's condition was pathetic when the count came, how much more so was the condition of the poor of Munich! On many a street corner a small child would hold out its hand to passers-by and say, "I am cold and hungry and afraid to go home. My mother told me to bring home twelve *kreutzers*, and I have only been able to beg five. My mother will certainly beat me if I don't carry home twelve *kreutzers*." And a *kreutzer* was only a half a cent!

Everywhere there were beggars. Some, like the child described, were truly pitiable. Some were kidnapped children, who had been purposely maimed or blinded to present a more touching sight. Not all the paupers, however, were crippled and weak. Some were strong. These plagued those who passed by until they gave them an alms to be rid of them. Sometimes in their begging they would enter houses and take whatever they saw. Munich had a population of sixty thousand, and its beggars ran into the thousands. To them begging

was a profession. Regularly they appeared on certain beats which they regarded as their exclusive territory and from which they routed any newcomer attempting to cut in on their clientele. There were alliances by marriage within the caste and gang wars when lines were crossed.

The citizens of Munich hated the condition, but previous efforts to uproot it had proved unavailing. As Chief of Police, Count Rumford was given full scope to remedy the condition. Here the professional soldier became an amateur sociologist. He realized that to some it would "appear extraordinary that a military man should undertake a work so foreign to his profession as that of forming and executing a plan for providing for the poor." For this reason he felt it necessary to defend his interest in the poor.

Probably because he was an amateur, free from tradition, his method was entirely novel. Poverty, he said, was increased rather than lessened by the remedies commonly applied to remove it.

To make vicious and abandoned people happy, it has usually been supposed necessary, *first* to make them virtuous. But why not reverse this order! Why not make them first *happy*, and then virtuous! If happiness and virtue be inseparable, the end will be as certainly obtained by the one method as by the other; and it is most undoubtedly much easier to contribute to the happiness and comfort of persons in a state of poverty and misery than by admonitions and punishments to reform their morals.

First, he must make men happy. To do that, they must be made industrious. They must be given work. But these beggars could do nothing. All they knew was the art of begging. Clearly they must be taught

how to do something that would bring them a wage and make them self-supporting. He answered the proposition that they should be given a dole, with this fundamental principle of his :

It is most certain that all sums of money or other assistance given to the poor in alms, which do not tend to make them industrious, never can fail to have a contrary tendency, and to operate as an encouragement to idleness and immorality.

He was a soldier but he had a heart. The poor must be helped, and the charitable and willing exertion of individuals must effect this aid. "No body of laws, however wisely framed, can in any country, effectually provide for the relief of the poor without the voluntary assistance of individuals." It was the demonstration of interest that he felt of supreme importance in this social work—not the levying of taxes. But again, the usual method of showing concern for the pauper was to give him an alms. This did no good at all because it did not tend to make the poor industrious, and it took power from any organized method of aiding them.

Clearly then his first task was to find some method of employing paupers. The elector gave some money toward his scheme, but how could there be much hope of success, when every plan to date had failed? A large, abandoned factory was bought and completely renovated. Master carpenters, smiths, turners, spinners, weavers, clothiers, dyers and saddlers were engaged to teach the poor the trades. The necessary raw materials and tools were stocked. Rumford's preparations were purposely completed by a New Year's day. This would be a splendid time for his manoeuvre, since on this fes-

tival people were a little more generous and the beggars a little more audacious.

Rumford's plan was to take into custody all who were found begging. He himself made the first arrest. Going into the street with some of his lieutenants, he was immediately accosted by a beggar. Putting a hand on his shoulder, the count said, "You are under arrest. Go quietly with these officers to the station where your case will be investigated. If you are worthy, you will be taken care of."

Many soldiers were busy that day, and in the cleanup twenty-six hundred were arrested. They were immediately released with instructions. Those who could work were told to appear the next day at the factory, The House of Industry, where they would be paid for working and would receive a full meal free of charge. But there was to be no more begging.

Now it was necessary to solicit private funds, especially for those who were genuinely in need of aid. Rumford himself approached people for subscriptions. The names of those who gave were made public, and contributions of the smallest amount were accepted from the poorest people, principally for the good it did them. Likewise, the list of those who received the dole was made public. They had been bothered by beggars and now they knew that if the scheme were encouraged, they would actually save money. Butchers and bakers, who had previously been forced to give meat and bread, were glad to make their donations directly to the House of Industry.

The first attempts at teaching the poor were very discouraging. In the first three months, the experiment lost money. So many of these people had so little skill

that they ruined a great deal of raw material. In the beginning, the spinners were put to work on hemp which, if destroyed, would be less costly than wool and cotton. They were paid while learning and though their inferior products were not marketable, nevertheless he encouraged them. Soon there were evidences of developing skill. As the quality of the work improved, the House of Industry began to show a profit. Those who had gone hungry were now well fed. Those who formerly went almost naked in the cold of winter were not only earning clothes for themselves but clothing the army as well. The experiment was, moreover, changing these unfortunates into happy men and women.

Of course, there must be discipline, but he insisted that there be no harshness or force. He knew the value of rewards in shaping human conduct. Those who made exceptional progress were praised and pointed out to strangers, put in a position of prominence. When their work was worthy of notice, they were given a special uniform of which they were very proud. Mothers came to their work with their small children. They were put in chairs around the wall and received three *kreutzers* at the end of the day. As they grew to observe the constant industry around them, they cried to be given a chance to learn to spin. Child labor, of course, but an hour in the morning and an hour in the afternoon were set aside during which these children had to attend a school in the building.

Count Rumford did not organize his enterprise and then abandon it after it was started. Here was enough work for him—and glory too. As he walked through the House of Industry, he was not count, but a king. Mothers working at spinning wheels stopped at their

work to wish him God's blessing. They were happy. Men who had formerly been able to use their hands for nothing but to reach for alms proudly displayed their work and were pleased when he praised their skill.

The people loved this count. He had not given them money to be rid of them. No, he had treated them as human beings. His personal interest—"the demonstration of concern," which he claimed necessary in dealing with the poor—was what won their affection. When he was ill on one occasion, the poor went in procession to the cathedral to offer public prayers for him, though he was a Protestant, and they Catholic. Their great benefactor was supposedly dying, a martyr, in his service to them. Later when he fell ill at Naples, they set apart an hour each evening, after they had finished their work, to pray for him.

"I dare venture to affirm," he later wrote, "that no proof could well be stronger than this that the measures adopted for making these poor people happy were really successful." One may judge of the esteem in which he was held when the people of Munich erected a monument to him while he still lived. It was dedicated to "him who eradicated the most scandalous of public evils, idleness and mendicity; who gave to the poor help, occupation, and morals, and to the youth of the Fatherland so many schools of culture." Beneath was the command, "Go, wanderer! try to emulate him in thought and deed, and us in gratitude."

RUMFORD's scientific interests fitted very well into his social program for the poor. Throughout his entire life he was interested in heat, particularly in its practical uses. He was constantly trying to produce more heat

from less fuel, a study which benefited rich and poor alike. It was his belief that most grates did little more than heat the chimney. Often in those days the houses of the wealthy were full of smoke, because the architect did not understand the proper construction of grates and chimneys. He claimed to have rid about five hundred homes of this defect.

In his opinion much good food was wasted because of the improper construction of the stove. Food was scarce in the homes of the poor and should not be ruined in preparation. Nor should fuel be wasted. On a trip to Italy he observed how wasteful were the cooking fires in institutions for the poor. This was especially deplorable because fuel was scarce in Italy. He gave directions for the rebuilding of these fire-places, and when they were put into use, only one-eighth of the fuel formerly used was required.

The economic preparation of nutritious food was a study of greatest importance for the poor. In his essays he goes into details about the cost of food for the great numbers that took dinner each day at the House of Industry, often as many as fifteen hundred persons. Interesting, too, is another essay: *Of the Excellent Qualities of Coffee and the Art of Making it in the Highest Perfection*, which is accompanied with various illustrations of urns.

Later, when he took up residence in England, he founded the Royal Institution, enlisting by the power of his personality, the co-operation of the most notable people in England. But his associates disagreed with him over the purpose of the society. Rumford, like Franklin, was primarily interested in the practical side of life. It was his belief that the Royal Institution

should be interested in the study of economical ovens and the proper construction of fire-places. Other officers felt that the institution should direct its efforts toward purely scientific research. Rumford was not much interested in this and so withdrew from the enterprise.

But it must not be imagined that Rumford had no interest in the theory of subjects dear to his heart. On the contrary, he made a well-known contribution concerning the nature of heat. In that day it was commonly held that heat was a substance, a kind of fluid. Rumford had spent a great deal of his time studying this phenomenon and always had his eyes open for anything that would help him solve a problem so vexing to the scientists of that time.

One day in Munich, while supervising the slow process of drilling a cannon, he stooped to pick up some of the metallic grindings that fell from the boring tool. What made these chips so hot? A few grains of metal did not produce all this heat. It was friction. He saw it all in a moment, but how was he to prove it to the learned men of the Royal Society?

He planned his experiments and carried them out while still in favor at Munich. Into a piece of discarded cannon, which had been partly bored, he inserted a dull drill. This was put into a container, holding about nineteen pounds of water. Then the horses furnishing power for the drill were started. After two and one-half hours, the water about the cylinder was boiling. All this heat did not come, he argued, from the bit of metal dust that was drilled out by the borer. The heat was not furnished by the metal, nor did it come from the air. Heat was not a material. If it were

a material, its supply would be exhausted by friction, but this heat was inexhaustible and depended on the friction expended. Heat must therefore be a motion. When Humphry Davy, his protégé in the Royal Institution, demonstrated by rubbing two pieces of ice together that the friction would bring about liquefaction, Rumford's theory was further established.

Count Rumford spent eleven years of his life in Munich. Eventually opposition arose to a foreigner who possessed so much power. He went to England but was recalled, however, when Austrian and French armies threatened to capture Munich. He returned in time to prevent the occupation of the city. By way of appreciation his patron sent him as Ambassador to the court of the King of England. Upon his arrival he found that the king would not accept one of his own subjects in that capacity. Nettled at this, he decided to go to America where he would live as a German nobleman near Cambridge, Massachusetts.

What would the states, now free, say to that? President Adams was pleased and offered the count his choice of two military positions. While these negotiations were in progress, he became interested in organizing the Royal Institution and altered his plan of going to America. But after his differences as to the policy of the institution, he retired to France, where he moved in the most distinguished circles.

There he met the widow of Lavoisier. He was free to marry now, since his wife in America had died several years before he left Munich. What promised to be an ideal marriage turned out dismally. In less than four years they separated with the most hostile feelings toward each other. He had locked out her guests; she

had retaliated by pouring boiling water on his flowers.

Rumford was essentially a courtier, pleasant — when he wanted to be — and ingratiating, a man who had the faculty of getting on in the world. Yet he had more than a pleasing personality. He possessed a mind rich in a variety of fields. Besides being a soldier, who was an inspired amateur in science and sociology, he was a skilful musician, a mathematician, an exact draughtsman, a linguist, a student of medicine and surgery, an author, and an inventor. In most of his work Count Rumford had service to others in view; the benefactions of this international man were so numerous and widespread that four nations mourned his passing.

IV
A MUSICIAN LOOKS AT THE STARS
WILLIAM HERSCHEL

“Music was long his pursuit, astronomy his pastime; a fortunate event enabled him to make astronomy his pursuit, while keeping music for a pastime.” — *Agnes M. Clerke.*

IV

A MUSICIAN LOOKS AT THE STARS

WILLIAM HERSCHEL

THE Seven Years' War was the World War of the eighteenth century. In this conflict a million men lost their lives on battle fields from India to America. Prussia and England united against France, Austria, Russia, Sweden and Saxony. Great Britain had sided with Frederick of Prussia because the English kings, the Georges, were from Hanover and they wanted to save their heritage from the rising power of Prussia's war lord, Frederick the Great. England was especially interested in overcoming the French forces. This she did, though there were battles in which the British were totally routed.

One of these battles was fought at Hastenbeck in Hanover, and one of the soldiers who took part in that conflict—at a safe distance—was William Herschel. As he lay in a ditch on the night after this battle, he told himself that this war was a stupid business. He had enlisted some four years before because he wanted to play in the band with his father and brother. That feature of the army he liked, but this wallowing about in a muddy ditch, especially when a man was sickly . . . Wasn't a person a fool to stay on helping men, mad with ambition, to build up empires? Well, he had ambitions of his own. One only lives once. Why not desert? He would go to England where his regiment had been quartered two years before.

Life was hard for the deserter the first few years, but

soon his musical talent brought him employment. Ten long years passed before he reached the enviable position of organist at fashionable Bath. Here he became a popular teacher. Why shouldn't he? He was handsome, affable, talented. With boundless energy he set about the task of giving lessons, conducting concerts and composing music.

But he could not keep at his music perpetually; there had to be some recreation. Years before, when in the Hanoverian Guard, he had given evidence of his serious interest by buying Locke's *Essay on Human Understanding*. Since that date he had constantly studied to supplement what he had been taught at the garrison school at home. To unbend his mind from the rigors of a day spent at teaching music, he gave his evenings over to the study of mathematics, optics and astronomy.

After becoming established at Bath, he went back to his home at Hanover to visit his family. He had made good and he was welcome. None was more anxious to see him than his sister Caroline. She had been brought up very strictly by her mother who, unable to write herself, felt that education for women was superfluous, that woman's place was in the kitchen. The father of the family was not so strict with Caroline. He early discovered that she, like her brothers, had musical ability, but when he wanted to give her lessons, Frau Herschel objected, and it was only when she was not at hand or in an exceptionally benevolent mood that the father could give Caroline any instructions. When the father died, Jacob, the oldest of the brothers, came into the dignity of head of the house and carried out the policies of his mother with reference to his sister Caroline.

"You don't look very happy, Lina," we can imagine

William saying when he came home. "Why are you so gloomy?"

"You don't know how lonesome I am here at home since father died, and you have gone so far away to England. I often wonder what will happen to me when the family breaks up."

"Well, you'll be getting married one of these days."

"No, I'm getting too old. Girls my age are married. I know I'm not beautiful, William, and you know it, too. I have never been allowed to do anything but work. There's nothing I can do that interests anybody. Even when I wanted to learn some dressmaking and millinery, brother Jacob stormed about it and only let me go if I'd make only useful things—no fancywork. Jacob doesn't know it, but I did learn to do some fancy stitches. Sometimes I have a chance to knit before the boys get up and want their breakfast."

"Now don't worry," said William sympathetically. "You practise your singing—you have good timbre in your voice—and then one of these days I'll come for you."

On a later visit William suggested that he take Caroline to England. The family vote was decidedly against the plan. Who would cook and scrub and polish if she went away? But finally she was permitted to go when William offered to pay the wages of a servant to take her place.

If Caroline was busy at Hanover, she was still more so at Bath, for life in her new surroundings was always at fever heat. But there was a world of difference between the day's work in Hanover and here in England. Now everything she did was new, interesting and educational. She took lessons in English, music and the

business of becoming a lady. Her brother was so busy that they had little time together except at meals. It was then that he educated her. Her progress in singing pleased him so much that soon she was playing the leading roles in his oratorios and training the sopranos. In addition to this, she copied the music for the vocal parts and for an orchestra of over one hundred pieces.

The more routine work that he could pass over to Caroline, the more time William had for study. Night after night, when his sister felt he should have been sleeping, he was sitting up in bed reading books on astronomy by candlelight. Each night the subject so fascinated him that he read on for hours, forgetting the passing of time. Though thirty-five years of age, he had not yet peered through a telescope. He decided to satisfy his curiosity and rented a small reflector. What he saw only awakened a deeper interest instead of satisfying him. He must rent a larger reflector. But no larger instruments were made, though he was told that one could be manufactured for him, if he had the money.

But his budget could stand no such expense. If men made these telescopes, he told himself, he could do it, too. He bought tools from a Quaker who used to polish mirrors and went at the making of telescopes with the enthusiasm he showed in everything. Immediately the Herschel home began to look more like a factory than the residence of a popular young music master. Their mechanically minded brother Alexander had put in his appearance. He was given a lathe which was set up in one of the bedrooms. The furniture in the drawing-room was pushed to the wall to make room for a cabinet-maker's tools. "What would my good mother say,"

Caroline asked, "if she came into this house and saw everything in such disorder? I can even hear her scolding." But Caroline swallowed her indignation and before long she was absorbed in her brother's desire to build a telescope bigger and better than any previously built.

But this craft was not to be learned in a single day. It was a tedious and discouraging business, especially when they had nothing to instruct them except their own mistakes. Herschel never told the world how he made his telescope, but it is easy to imagine some of the difficulties he encountered. There was the problem of finding a metal that would take a high polish and retain it. Then they must learn to cast this molten metal. Of what substance would the mold be made? After many experiments he came to use loam mixed with sifted manure.

Time and time again his castings developed flaws. Once he succeeded in making a good casting, the long task of grinding the concave surface and polishing it by hand began. All this had to be very accurate, if true images of the stars were to be reflected. He tells us that after about two hundred mistakes he finally produced a satisfactory, five and one-half foot telescope. It had cost him much toil and study, but when he had finished it, he was out in the front rank of telescope makers.

Now that he had learned his art, he kept on improving his instruments so that he could see farther and farther into the depths of the heavens. This was now his passion—to make bigger and better telescopes. But the day was never long enough. So many hours had to be given over to music, and much of the night was spent

in viewing the skies. Eight years of constant toil followed the day when he first looked through a telescope. Then one night while studying the constellation Gemini, his instrument reflected an unexpected light.

"This is no ordinary star, Lina. It has a disk. I think it is a comet."

Immediately Herschel wrote a letter to the Royal Society on the subject. But after he observed the star's course in the heavens, he was convinced that it was a planet — the first that was ever discovered by a telescope, the other five having been known from antiquity: Jupiter, Mercury, Saturn, Venus and Mars. Herschel had extended the boundary of our solar system, for this new planet was farther distant from the earth than Saturn and required over eighty years to complete its orbit. And the organist had done it all in his leisure with instruments he had made himself! The learned world was aghast.

George III was interested and wanted to see the star. Herschel was glad of the opportunity to visit court and brought his instruments into the royal presence. But before they would gaze at the stars, there was this matter of his desertion of the Hanover army to be considered. Solemnly the king handed him papers in which he was declared absolved of his disloyalty. His Majesty was pleased with Herschel and his discovery, a pleasure that was doubtless increased by the fact that the discoverer came from Hanover, whence the Georges came. To show his appreciation, he appointed Herschel to the post of Royal Astronomer with a pension of two hundred pounds a year. When William spoke up to say that his sister Caroline was indispensable, she was given a pension of fifty pounds a year.

Once Herschel was out of the kingly presence, he shouted for joy. Now he was free from that soul-sapping routine of giving lessons to every mother's daughter who could pay the fee. Now he would accomplish things. Immediately he wrote to Lina about the king's pleasure at seeing the new planet and the honors that had been heaped upon him. Even the small telescope he had brought with him was superior to those at the Royal Observatory. The praises people were showering on him only proved how little they knew. "I will make such telescopes and see such things—."

The king had honored Herschel; Herschel would honor the king. He wrote a pompous letter to the Royal Society in which he stated that there was no reason why the new body should be called after some god or goddess of antiquity. Why not call it *Georgium Sidus*? Was the discoverer not "a subject of the best of Kings, who is the liberal protector of every art and science . . . a native of the country from whence this illustrious family was called to the British throne . . . a member of that society which flourishes by the distinguished liberality of its royal patron; and, last of all . . . a person now more immediately under the protection of this excellent monarch and owing everything to his unlimited bounty?" But in spite of his flowery appeal the new planet was called Uranus.

When a man reaches eminence, he is often inclined to sit back and enjoy his new ease with dignity. But honors were not fatal to Herschel's advance; rest was the farthest thing from his mind. How could he rest when he wanted to see farther and farther into the heavens? To do this he would have to make a thirty-foot telescope or perhaps a forty-foot one. His ambi-

tion was checked when he remembered his income. It was difficult enough to keep Alex and Lina on two hundred pounds a year, without sinking money into a project so expensive as a forty-foot telescope. How to get sufficient money was his problem. Different governments would pay him handsomely if he would build some of his excellent instruments for them. He hated the idea of slaving to make telescopes that would pass into other hands, but he saw no other way out. Later he was to marry a wealthy widow, who would chase the wolf from the door. But now he needed funds.

Herschel began to manufacture telescopes, but the king, learning of his ambition, loosened the royal purse strings and gave him some two thousand pounds and a generous annual allowance for the maintenance of the instrument. In the midst of the work, he ran out of money. Unforeseen difficulties had arisen. The first reflecting mirror had been too thin. The second cracked in the cooling. But the king did not desert him. Another two thousand pounds came from the royal purse. His third mirror, weighing well over a ton, was not satisfactory until it had been worked on for ten months.

Meanwhile the whole enterprise had captured the public fancy. Sightseers came to walk through the tube. Among the number was King George, accompanied by the Archbishop of Canterbury. The king went ahead, and the archbishop stumbled along after him, unable to find a sure footing in the darkness. His Majesty turned to him and with royal humor said: "Come, my lord bishop, I will show you the way to heaven."

With the new telescope Herschel discovered the fifth

and sixth moons of Saturn. Yet he was not happy about this new instrument. The mirror was sensitive to changes of temperature, which caused inaccuracy. After a short time the reflector lost its luster and it was never repolished. Moreover it was too unwieldy for practical purposes, two men being required to operate it. He figured that if he were to make a review of the heavens with this instrument, it would take eight hundred years.

Modern attempts to make larger telescopes are in a direct line with the work of this amateur. How interested he would be in the present manufacture of the world's largest reflecting mirror, poured in Corning, New York, to be put in position on Palomar Mountain, California. We can imagine him among the throng of those who recently looked on when the cooled reflector, weighing twenty tons, was taken from the oven. How interested he would be in this new reflector, weighing sixteen times as much as the one in his forty-foot telescope and having a diameter of two hundred inches, four times his own.

In praising Herschel one must not forget that he accomplished so much because his sister devoted her whole life to his success. She was always at his side to help him. When he was sweeping the heavens with his instrument, she was ready to jot down what he observed, even though the weather was often so cold that the ink froze. Then during the day she would make calculations based on what they had observed the previous night. When he was busy polishing a mirror, and could not stop until it was completed, she would put food into his mouth or read aloud to him from the novels of Fielding and Sterne. At other times she helped at

tasks so uninspiring as the sifting of the manure needed for the castings. But her work was not always menial. She, herself, learned to watch the skies and discovered two nebulae^a and five comets.

When her brother died at the age of eighty-four, she decided to go back to Hanover to die, but death does not always come when it is welcome. She lived on for twenty-five more years, reaching almost a hundred, always busy making catalogues of stars. She was not forgotten in her lonely retreat. Many illustrious savants came to visit her; many distinctions were conferred upon her in terms so flattering that the modest Caroline thought that those who wanted to do her honor were making sport of an old woman.

But sometimes as she sat propped up in her bed, her eyes would dim with tears as she dreamed of those days in England when her brother and she were so busy and so happy. Again she was singing and he was conducting, or she saw herself smiling as she read some amusing scene from *Don Quixote* while William was polishing a mirror. Then she remembered his marriage. It upset her at the time, but nobody would ever learn her thoughts; she had destroyed her diaries for those years. After all, who could be angry with him for marrying so kindly a widow? Certainly the son, John, born of that marriage, had fulfilled his father's dreams. But John had never had to fight his way up from poverty. It was William who was the superman.

V

SCIENCE IN A MONASTERY GARDEN

GREGOR MENDEL

“Biology was one of his numerous avocations, like playing chess, organizing fire brigades, running banks and fighting governmental taxes. He was really a physicist, and brought to one of the great problems of biology the attitude of mind and the quantitative method of attack which has been in use for some time by physicists and by astronomers, and which was just coming to be used more widely by chemists.” — *Professor E. M. East.*

V

SCIENCE IN A MONASTERY GARDEN

GREGOR MENDEL

AN ambitious young man once wrote to Luther Burbank, the plant wizard, asking him what works of Mendel he should read. Perhaps the youth was only interested in adding another autograph to his album, but it may be that he had heard of Mendel's famous theory and, being a lonely scholar, honestly sought direction from the great plant-breeder. Burbank was never slow to speak his mind. "My advice to you," he wrote, "is to start Mendel by reading Darwin, and then let Mendel go and read more Darwin." In other words, there was nothing worth while in Mendel.

The practical doer is often inclined to ridicule the man who tries to work out a rule or formula. Burbank's advice is typical of the practical man's lack of sympathy with the theorist. He was a nurseryman who gave up that work to become an amateur botanist. His ability lay in the keenness of his senses. This enabled him to pick out at a glance young plants possessing those characteristics which he wished to perpetuate, but, though he had a world of patience and industry, he had not the scientific temper. He certainly did the youth who sought his advice no service in prejudicing him against Mendel's experiments. His dismissal of the monk and his work with an airy gesture leaves the impression that he was giving advice in a matter about which he had no first hand acquaintance. Certainly he could hardly have read the monk's brief paper.

But Burbank was not the first man to ignore Mendel's work. In fact nobody ever paid any attention to him during his life. He was born a generation before his time. He performed a brilliant experiment, but few listened to him, and those who did failed to understand. The seed fell on stony ground and would not grow, but Mendel never doubted that it was good seed.

We can imagine the feelings of the members of the Brünn Natural History Society as they came together one winter night in 1865 to hear one of the world's great scientific papers. No one of the forty members realized the importance of the occasion. To many it was just another talk. Perhaps there was a special reason for attending this particular meeting. Father Gregor Mendel, one of the Augustinian monks from the local monastery, was to read a paper on *Experiments in Plant-Hybridization*, and though the effort might be neither very interesting nor informative, still this sort of thing in a clergyman should be commended.

Intellectually the speaker did not enjoy much of a reputation. He was only a *supplent*, that is an extra teacher, who in spite of all his time in school had failed twice in trying to secure an ordinary teacher's certificate. He was not even licensed to teach in a high school, and here he was, standing up before the local intelligentsia to tell about his experiments with edible peas, conducted in a little corner of the monastery yard.

While the crowd assembled to listen to his essay, Mendel sat waiting with his paper, written in a beautiful hand, before him. If we could talk to his friends in this audience, they would tell us of his background. They would tell a story of his early poverty. He had his roots in Austrian Silesia where the family's condition

was so low economically that his father had to work without pay three days of each week on public works, a relic of feudal days. By a series of great sacrifices the boy had been given an education.

First he attended the local school, where the pupils learned something of bees and fruits. The priest in charge of this school was rebuked on this score by the school inspector, and in the report to the archbishop this unusual course of studies was termed a scandal. As a result of this scandal, bees and fruits became a major interest in the boy's life.

Later he was sent to a high school twenty miles from home as a half-ration student. The understanding was that his parents would supplement the bill of fare at the school with occasional boxes of food from the farm. They suffered some reverses, but he was able to eke out the barest existence by tutoring a little. Sickness, brought on no doubt by the combined assault of worry over money and his next meal, overtook him three times during his student days.

He had gone on to the priesthood and was ordained at the age of twenty-five. It immediately became evident that he was unsuited for parish work. His tender nature recoiled at the sight of human pain and misery, encountered at every turn in his parochial duties. Soon he worked himself into a position where he taught Greek and mathematics. Meanwhile he prepared in his leisure to pass the examinations that would give him professional standing as an instructor. At twenty-eight he was examined for certification to teach science. He failed. His superiors felt that he should be given a chance to study with professors, instead of teaching himself, and so he spent about two years at the Uni-

versity of Vienna, where he applied himself to science exclusively. After his return he secured employment at the Brünn Modern School and applied for permission to take the examination that would make him a certificated teacher in a high school. Surely there would be no difficulty now, after all his experience at teaching and his study at the University of Vienna.

Gregor Mendel at about the age of thirty-four was admitted to the examination.

Nobody knows what happened, but when he came back to the monastery, sadness was written on his face. Nobody had the nerve to probe into his wounds. If he ever told his friends, they guarded the reasons very carefully. It is certain that the certificate was not granted. We can only surmise what the causes of his failure were. It may have been that the examining board, with open texts upon their knees, chose to "roll" him for some inscrutable reason.

They may have made the examination so difficult and specific that he could not answer their questions. Or it may be that Mendel ardently defended his personal views in opposition to a canonized opinion of an examiner. Mendel was easily capable of this, having certain stubborn, peasant traits. At any rate the report went the rounds that he had crossed the doctor who had examined him in botany and had maintained his views with too much vigor. He made no further attempt to pass the examinations, but returned home and, fresh from his humiliation at Vienna, significantly began his experiments in botany, which lasted for eight years, when he was interrupted because of the prevalence of the pea weevil. But his experiments had been sufficiently extended, he felt, to offer certain conclusions.

And this material was what he presented to the members of the body of local scientists in Brünn (now Brno). We can imagine the scene. The president announced that they were privileged to hear the results of Father Gregor Mendel's experiments with edible peas. He would not be able to finish the paper at this meeting, but he would conclude his remarks at the following session. Father Mendel looked out over his glasses at the crowd and began to read. There was no preparatory joke to capture the benevolence of his hearers. Everything about his manner indicated an intense seriousness, for now he was to make public the fruit of his long study.

Instead of attempting to study the problems of heredity by crossing different species, Mendel had struck on the idea of simplifying the matter by crossing plants, which showed contrasting characters within the species, with others of the same species. Thus he noted seven pairs of contrasted characters in peas. Some peas had wrinkled surfaces and some smooth, some had green cotyledons and some yellow, some had long stems and some short, and so on. He had crossed these opposite characters, covering the cross-fertilized plants with bags to make certain that no bees or insects would disturb the pollen and thus frustrate his experiments. He had taken infinite patience and kept the most exact records.

Mendel discovered that no matter what resulted in the first generation, even though one of the characters seemed to have disappeared totally, the contrasted characters reverted to type in the second filial generation. For example, when peas having green pods were crossed with those having yellow, both green and yellow podded

peas appeared in the second filial generation. This reversion to type worked itself out in definite proportions; dominant tendencies were proportioned to the recessive as three to one. This ratio was predictable. Then he became more obscure when he began to explain what happened when more than one pair of contrasted characters entered the crossing.

Those who knew botany were disturbed by all these mathematical ratios. Some of the members had had difficulty in keeping their attention on what the priest was reading. Others who had dined only a short time before had a hard time fighting off sleep. A few heads had bobbed at the lectures, but everybody managed to join in for the applause. Some added a few extra claps, remembering that after all this was a monk talking about science. He at least had refused to become a medievalist. Such men should be encouraged, even though, of course, the effort might be ill-advised and out of the approved, scientific grooves.

Mendel was pleased with the applause. He mopped his brow while waiting for any question that might be put to him. He had no fear that he could not defend his position. Hadn't he read widely during the years of his experiments? Hadn't he bought Darwin's works as they had appeared? He could show his annotated copies. But nobody asked a question. They weren't interested. Could it be that they were ignoring his work? The order of business was resumed. A prominent professor of botany led a discussion on Darwin's *Origin of Species*, published some six years before. There was something of a rebuke in the professor's choice of a subject, for whereas Darwin had shown the variability of species, Mendel had attempted to show the constancy,

if not of species, then at least of certain characters within a species.

Mendel was sad again this evening as he returned to his monastery. "How did the talk go?" we can imagine his fellow monks asking him. "Nobody paid the least attention to it. So many years I have studied about the heredity of peas, and then the learned members of the Society for the Study of Natural Science never even ask a single question. Well my time will come one of these days."

But he was cheered when he remembered that his paper would be published. Certainly the learned authorities in the great centers to which exchange copies of the proceedings were sent would recognize his ability and the truth of his conclusions. One hundred and twenty copies of the transactions were sent to as many intellectual centers, where librarians had them catalogued and put up with the other dusty numbers, in the hope that some day by some chance someone might call for them. But nobody read the work, and Mendel's paper seemed bent for oblivion. Mendel waited. Nobody reviewed his work. But still he said, "My time will come one of these days."

Here was a plain instance of a case in which the parading professional had tripped over his sword. The conclusions of a brilliant amateur passed unnoticed before the eyes of the learned world. If a noted scholar had written the paper, it would have been read, but Mendel was obscure. He was not an authority, and hence the leaves of his contribution remained uncut.

Soon an event occurred in Mendel's life which changed its whole course. Three years after he read his famous paper, he was elected abbot of the monastery of Alt-

brünn. In the educational world he was only an extra teacher of physics in a high school, but, in the eyes of his fellow monks, he was worthy to be their leader. He accepted the new duties and at first imagined that he would enjoy sufficient leisure to pursue his private studies.

For a time he did, but he was soon deceived. The executive duties of his office robbed him of his leisure. His plants bloomed and died with little more than a fleeting visit from the busy abbot. He had been interested in bees, too, but this interest was also dropped. Probably he gave up his studies because he could not count upon having the time for any experiments that he might have in mind. He took some recreation, however, for he travelled about over Europe a great deal. This proves how incorrect it is to imagine that he led a cloistered life within monastic walls.

Mendel took his duties as a prelate seriously, an instance of which is seen in his contest with the state over a period of ten years. In 1874 a law was passed that ecclesiastical benefices and religious communities should make specified contributions to the fund used for defraying the expenses of religion. The ruling was not anti-religious but aimed at more equally distributing the church's means among its less fortunate ministers. Mendel's stubbornness now came to the fore. With an unbelievable tenacity he fought this exaction to the very end of his life. Finally the government officials were forced to become drastic and collected rents ordinarily received by the monastery. In this way accounts were balanced. Mendel became an embittered man, especially when even the brethren within the monastery opposed his policy in the tax dispute. To their way of thinking

he did not manage the affairs very diplomatically. This is proved by the fact that immediately after his death the difficulties with the government were settled.

He now began to suffer from kidney trouble, a condition that was not helped by his devotion to nicotine. He started using tobacco at the suggestion of a physician who told him that smoking would keep him from becoming too fat. But the habit grew on him so that he was known to smoke twenty cigars in a day. But he still remained fat. Friends of his bishop might smile when they remembered that, as a young cleric, Mendel had said that his lordship possessed more fat than understanding, a remark that reached the episcopal ear.

There were few genuine mourners when he passed away, for his stubborn opposition to the taxes had served to lessen his previous popularity. When he was laid to rest, everybody thought that this was the end of Mendel. They knew that he used to say, "My time will come one of these days," but they felt that he had only been bolstering up his courage. When he was in the tomb some sixteen years, he burst his winding sheets and, like Lazarus, came forth from the dead, as he had prophesied he would. About the turn of the century, three scholars working independently on the problem which Mendel had studied in his forgotten paper, came to conclusions that verified what he had done. By the merest chance his study was discovered.

From that time to the present his name has been held in honor in the annals of science. Mendel's experiments have become the corner stone of the science of genetics, and elaborate experiments, inspired by this amateur, have been carried out with plants and animals.

It is unfortunate that Darwin never came upon Men-

del's paper. A careful search of the great scientist's library by his son failed to reveal any trace of the work. Darwin might have revised certain of his views when confronted with such telling evidence. But Mendel was born before his time. "Great as was the advance in cytological genetics during the later half of the nineteenth century," wrote Professor E. M. East of Harvard in a paper written in honor of the centennial of Mendel's birth, "one can not imagine an appreciation of the Mendelian type of work by any of the investigators. Their minds were too carefully focussed on the individual fact. Either Darwin or Galton would have seen the truth clearly; but then Darwin and Galton were amateurs who were not trammelled by professional connection with the guild of biologists."

Here then is another instance of an inspired, but in his day unappreciated, amateur pointing out a higher ground to the professionals.

VI
THE STONEMASON OF CROMARTY
HUGH MILLER

“Mr. Miller is one of the few individuals in the history of Scottish science who have raised themselves above the labors of a humble profession, by the force of their genius and the excellence of their character, to a comparatively high place in the social scale.” — *Sir David Brewster*.

VI
THE STONEMASON OF CROMARTY
HUGH MILLER

ALONG the eastern coast of Northern Scotland, the little town of Cromarty guards the entrance to the Bay of Cromarty. Nature is strong and unfettered in this region; to the north are the wild highlands, to the east the treacherous North Sea.

Hugh Miller, growing up in Cromarty at the beginning of the nineteenth century, seemed very definitely to belong to this wild region, for he, too, was untamed. He was a problem child. The gossips in the town lamented the fact that the boy's father had been drowned at sea, for he had been a strong man and would have "settled" the boy easily. But his young mother could do nothing with him. She could only wonder why providence had taken her two daughters and left her this son, who was already bringing disgrace upon her by plundering orchards and organizing a gang that was always up to some deviltry. She worried about him constantly.

He was a bright boy but he was not doing well in school. How could he, when he played truant three-quarters of the time? After a year in what was called the Old Dame's School, he passed into the grammar school of the parish where one poor schoolmaster herded one hundred and twenty lads and thirty lassies along the road to learning. Amid the bedlam that prevailed, the teacher seems to have preserved his sanity by taking special interest only in those who showed interest.

Hugh came under his notice as being a capable lad

who read a great deal, and for this reason he was promoted to the "heavy" class where he would take up Latin. But this new study required application of a kind that did not please him. It was much more interesting to read the translations of these Latin books and the biblical stories of the adventure of Joseph, Samson and David.

Some of the parents felt that their children were not getting the best possible training in this overcrowded school, and so a subscription was taken up to open another. To this institution Hugh Miller was sent. The new dominie had fewer students and could therefore keep them busier than they had been in the old school. Moreover, the new teacher knew that his school must surpass the leisurely, undisciplined and antiquated methods of the parish school, or else he would lose his position.

Young Miller, rebel at heart, was not willing to conform to these progressive ideas. In the Old Dame's School he had been taught to pronounce his letters one way, but the new dominie had a new method. He tried to teach the boy the approved pronunciation, but Miller stubbornly refused to change. The teacher determined to chastise such defiance. But his robust student of fifteen was not willing to submit to any punishment, and once the struggle began, there was some danger that the teacher himself might receive the whipping.

The students looked on anxiously. This was a test case and would determine how far the new master's methods and influence would extend. If Miller whipped him, rebellion would be general in the future. The two clinched and tried to throw each other. Miller stumbled over a desk. The schoolmaster pinned him down

on the floor and pummelled him unmercifully. The crowd of boys was a little crestfallen when they saw that their leader was getting a terrible drubbing. Finally the dominie let him up. The boy took his tam-o'-shanter and never attended school from that day on.

Now Hugh was something of a poet. He had been writing verses for three years. Immediately after his brawl with the dominie, he hurriedly composed a lampoon entitled *The Pedagogue*. A few lines of this sustained hymn of hate will show the unusual talent of this problem boy.

With solemn mien and pious air,
S-k-r attends each call of grace;
Loud eloquence bedecks his prayer,
And formal sanctity his face.

All good; but turn the other side,
And see the smirking beau displayed;
The pompous strut, exalted air,
And all that marks the fop, is there.

In spite of his rhymes and his reading, it was the common conviction of the gossips that he would never amount to much. Not only had he defied the school authorities but he had turned atheist as well. Some terrible fate must surely overtake so wicked a youth.

After leaving school, he was faced with the necessity of working to make a livelihood. Choice of employment was limited. After surveying the limited opportunities, he decided to be a stone-mason because its seasonal unemployment would give him some time to read and write. He was apprenticed and set out to his first day's work in a quarry. His heart was heavy. But soon he became interested in the firing of the gunpowder

with which rocks were blasted. He forgot his blistered hands in his eagerness to see the nature of the rocks.

There were strange markings on the uncovered ledges of stone. Some looked like the ripples of waves, others were cracked as though they had been the bottom of a dried-up pool. In these deposits stones that were rounded and worn rolled down with the blastings. It appeared to him that these stones had once been tossed about in water, but how would this high point have been the bottom of a body of water? There was nobody whom he could ask such questions; there were not even any books that he might consult. These mysteries became the subject of his thoughts.

The quarrying was too expensive at this point of the Bay of Cromarty, and the men were transferred to a lofty wall of cliffs overhanging the northern shore of the Moray Firth. Here he saw, laid out before his eyes, the crust of the earth where the story of its strata could be read as from an open book. A better place for the study of geology could not be found in any part of Europe. Yet he had nobody to enlighten him and he could only attempt to solve the puzzle unaided.

He picked up a nodule of limestone and cracked it open. Within it there was a delicate piece of nature's sculpturing, resembling one of the volutes of an Ionic capital. He opened a second. There was the imprint of a fish. In another there was a bivalve, in another a piece of wood. Was there anything so wonderful in all the world?

How lucky he was, he told himself, to take up this trade of a stone-mason. The other workmen were not interested in such things, but one, with whom he chatted about rocks, told him about stones called thunderbolts

to be found two miles distant. These possessed remarkable virtues in curing bewitched cattle. When he had a free afternoon, he visited the spot. He knew at once that these were not meteors, for a relative who had sailed to Java had brought home a meteor, and these stones were entirely different from that. Later he learned that their real name was belemnite.

By the end of his first year of apprenticeship, his interest in geology was thoroughly awakened. But still he was working in the dark. What a student with a text before him can learn in an hour was to cost him years of speculation. During his fifteen years as a mason, whether travelling about from one place to another as a journeyman or working in his own town, geology was the interest that made a life of toil bearable. His keen eyes were always on the alert to see what new fossilized wonder nature had to show him. This study ennobled his life and kept him from becoming a "Man with the Hoe," a dull slave at a boresome task.

It soon became clear to the gossips of Cromarty that Hugh Miller was no ordinary stone-mason. During periods of unemployment, he applied himself to books. Writing continued to be the passion of his life. He had his poems collected and published at his own expense. His poetry had its limitations, though one of his efforts has sufficient merit to find place in the Harvard Classics. Not only did his literary work create a good impression in his native town, but his character had so developed that even his former critics were bound to admit that they were mistaken. He had been thrown with riff-raff and had not been tainted.

While working at Edinburgh, for example, he was associated with workmen whose interests were entirely

sensual and whose hero was the man who spent in riotous living the most money in the shortest time. He could not be induced to join their debauches. On one occasion he did drink some spirits. Upon returning to his room, he found that the page of Bacon danced before his eyes. This experiment left a deep impression upon him. Then and there he made a resolution to avoid alcohol, a resolution which he kept. Yes, the village gossips were forced to admit that for once their prophetic gifts had failed them. Certainly he was growing up to be a model man, a poet, a good workman, a friend of the minister and a defender of the kirk.

It is characteristic of the rise of Hugh Miller that he made his advances by sudden leaps. Of these there are three. As a young stone-mason in Cromarty, he lived without any ambition to make a name beyond the confines of the parish. Then a Miss Lydia Fraser, a young lady of culture and intelligence, came to the village. She met him and told him how beautiful his poetry was. Then ambition stirred within him.

This girl was not indifferent to him, in fact it was quite plain that she admired him, but how could he hope to win a wife so far above his station economically and socially? Granting that she would have him, how could he dare marry so lovely a creature until he could supply her with those luxuries which had always meant nothing to him, but which she must have to live in the manner to which she was accustomed?

The girl's mother was profoundly interested in this new acquaintance which her Lydia was encouraging and, fearing that "her daughter might bestow her heart and hand on a mechanic, commanded that the intimacy should be broken off." This was a sorry state of affairs,

but the lovers still had their pens. They wrote long, restrained epistles, in which they relieved the anguish of their souls by reciting their woes. Hugh tried to keep from brooding by composing a book on the scenes and legends of Northern Scotland.

The man who had been so happy before with his books, his writing and his fossils was now thoroughly unhappy. He was willing to advance in the world, but he could see no ledge on which to set foot. Then this man, who had displayed no talent for arithmetic in school, was offered the position of accountant in the bank of Cromarty. With some distrust in his ability, he accepted the appointment, for this was the advancement and the security of income he needed before he could at all impress Miss Fraser's mother. After five years, Hugh married Lydia, the first and only woman he ever loved. The spirit of the marriage is shown by the fact that he gave his wife a Bible, inscribed with verses of his own, for a wedding present.

His second leap to higher ground was occasioned by a dispute between the congregations of the Scottish Church and their patrons, who appointed whatever ministers they wished without consulting or considering the wish of the people of the parish. To Miller this was a form of tyranny, a curbing of the free spirit of man. The devout young accountant would fight this throttling of freedom. He addressed to Lord Brougham, who had dismissed the claims of the Scottish Church, a pamphlet in which he defended the cause of the congregations.

The nervous vigor of his style obtained a wide hearing for the cause. Both Gladstone and O'Connell praised the protest. Those who were organizing the "Witness," which was being planned as the organ of the Scottish

Church, were attracted to this young banker in Cromarty and offered him its editorship. He accepted the position with as much self-distrust as he had that of accountant at the Cromarty bank. Immediately the paper gained a wide circulation because of his fearless articles.

It was through the columns of his magazine that he attained renown as a geologist, the third leap in his life. He had long been studying fossils, and this was his chance to write up his studies in a popular style. A month after the articles were begun, he was recognized as a geologist. Here the amateur's years of study produced fruit. These papers were later collected into a book *The Old Red Sandstone*. In this the stone-mason really enlightened the scientific men of his time. They had long maintained that the Old Red had no fossils or that at best it contained very few.

Miller proved that this formation, far from being barren of fossils, was really very rich in them. These he described in detail, even doing the illustrations with his own pencil. He had followed Agassiz, the great authority on fishes, in much that he had written, but he had made his own original contributions, in particular, about certain armored fish. Among these was the winged fish, having a head lost in its trunk, a humped back covered with bony plates, and two wings extending from its "shoulders."

The members of the British Society for the Advancement of Science met shortly after Miller's articles on the Old Red began to appear, and they were lavish in their praise of his work. One scientist maintained that he would give his right arm to possess the literary skill shown in Miller's masterly descriptions. Agassiz proposed that one of these species which the amateur sci-

entist had discovered should be called Miller's winged fish, and today it bears the scientific name *pterichthys milleri*.

Miller now became a recognized popularizer of geology. His next work was the *Footprints of the Creator*; for the American edition of this treatise Agassiz wrote a preface. His last work was *The Testimony of the Rocks*. In these volumes he attempted to reconcile the Biblical with the geological account of creation. A fundamentalist in religion, he labored unceasingly to prove the validity of the account of creation as told in Genesis. He had his difficulties, but at least to his own satisfaction he pointed out that the six days of creation were really six geologic ages. These days were successive revelations made to the mind of Moses.

"Rightly understood," he wrote in reference to the account in the book of Genesis, "I know not a single truth that militates against the minutest or least prominent of its details." He believed that everything was specially created by God. For this reason he opposed the Development Theory, which maintained that more complex beings developed from primitive organisms. In fact, his *Footprints of the Creator* was a reply to *Vestiges*, an unsigned work which had brought this theory to the public attention.

Darwin was to go much farther in his *Origin of Species*, but Miller died three years before it appeared in 1859. Had he lived, we may be sure that he would have gone to the front to fight Darwin and his theory of evolution. Miller, however, never realized that a later generation would be using his fossil discoveries to substantiate a theory which he would have termed both pagan and unscientific.

His sixteen years as an editor was a period of grinding toil, a prodigal outpouring of nervous energy. This began to tell on his health. In the composition of his last work he exerted himself beyond endurance. He complained to his doctor of intolerable pains in his head. He was having trouble putting two sentences together. Was he losing his mind? The modern doctor might suspect a tumor of the brain, but in 1856, the physician suggested that he should have his barber cut off some of his great shock of hair to cool his head.

He began to fear that robbers were interested in breaking into his little museum to steal his fossils. When he went to bed he kept a pistol and sword within reach. In fact he had always carried a brace of pistols with him since the days when he was in the bank at Cromarty, and he had not discontinued the practice after becoming an editor, because he feared that some one of his many antagonists whom he had lashed with his satire might seek revenge.

When he awoke, on the last day of his life, he imagined that he had walked out to his museum during his sleep. This fear and the burning pain in his head drove him to self-destruction. He rose from his bed, crazed with pain. He scribbled a brief note of love and despair to his wife. Then taking one of the pistols, he killed himself. By a curious irony the only one upon whom he ever used his weapon was himself.

His passing was regarded as a public calamity in Scotland. Eulogists proclaimed that his works would always be regarded as classics, ranking with the work of Addison, Hume, and Goldsmith. His books were widely read on both sides of the Atlantic and even translated into many languages. When Walter Scott died,

Hugh Miller was said to be the greatest Scotchman alive. Today his volumes gather dust on neglected shelves. Most of the encyclopedias carry an account of his life and works, but the *Encyclopedia Britannica* conspires in his oblivion by refusing even a line to his achievements.

VII

A JANITOR RISES TO REMARK

ANTON LEEUWENHOEK

“He was merely an ordinary shopkeeper, holding a few minor municipal appointments, in the little old town of Delft. In the world of science he was no better than an ignorant and bungling amateur — self-taught but otherwise uneducated.” —*Clifford Dobell*.

VII

A JANITOR RISES TO REMARK

ANTON LEEUWENHOEK

THE modern man of science often understands very little about the making of those instruments he uses with so much skill and precision, but the early scientists were frequently under the necessity of making the instruments by which they made their discoveries. To Herschel there was something very fascinating about the grinding of lenses for his telescopes. It is still a fascinating interest to amateurs, and thousands of people at this very moment will tell you that lens-grinding is their hobby.

Among Hollanders of the middle seventeenth century there was considerable interest in lens-grinding. Men wanted to explore the sub-visible world, objects so tiny that they could not be observed by the unaided eye. One day, a young Hollander named Anton van Leeuwenhoek — perhaps it was while he was learning the linen merchant's trade in Amsterdam — peered through one of these magnifying glasses. It may have been a flea that he examined, for this seemed to be so popular an indoor sport in those days that men called the instruments flea glasses. Then and there he was enchanted with the detail, and desire was born in him to see more and more of this great, undiscovered, invisible world. All around him were men who were setting sail to explore strange, distant lands. Here immediately under a microscope was the world that he would explore.

The Thirty Years' War was over, and Holland was ex-

periencing a post-war boom. A little over twenty years of age, with the trade of the linen merchant learned, Van Leeuwenhoek returned to Delft, his home, and set up in business. There were sources of revenue beyond his haberdashery. Before he was thirty he had been appointed Chamberlain of the Council Chamber of the Worshipful Sheriffs of Delft, a position which carried with it an annual stipend of about two hundred dollars for opening and closing the chamber when it was in session, and heating and cleaning the building. Later he was licensed as a surveyor and still later was elected wine-gauger.

But there was sorrow in his life during these years after his return to Delft. Of his five children only one survived infancy. Little did Anton realize, as he sat beside the deathbeds of these four infants, that the hobby in which he was indulging at the time, the making of powerful microscopes and the observing of "little animals," was the first chapter in a series of discoveries that would give children like his own an immunity against those dreaded diseases of infancy.

Through his forties he kept up his interest in examining everything microscopically. To do this, he made better and better lenses and mounted them between plates of brass, silver or gold. He was so absorbed in his interest that he made special lenses to examine a great variety of objects. To many who knew him he seemed to be gratifying a selfish collector's instinct. Why should a man want to make hundreds of lenses and refuse to sell them?

But soon citizens began to take notice when distinguished foreigners inquired for the residence of Leeuwenhoek. The word had gone abroad that his mar-

velous microscopes should be seen by all travelers who went to Delft, but the warning was added that a letter of introduction, preferably from the Royal Society, was absolutely necessary. The janitor was becoming famous. It was all because another noted citizen of Delft, named De Graaf, had told the secretary of the recently formed Royal Society of Great Britain about this fellow citizen who made microscopes revealing animals smaller than any that had ever been seen before. To prove his boast, he enclosed a letter from Leeuwenhoek.

The secretary was enthusiastic about this new observer and begged him to send on more descriptions of his work. Anton was flattered. He replied, giving three reasons why he had hitherto published nothing: he had no literary style, he did not know the arts or learned languages, and he did not gladly suffer contradiction or censure from others. But he accepted the invitation and began the lengthy correspondence that was to last for over half a century.

Van Leeuwenhoek soon began to feel his importance when the Royal Society elected him a full member. To him that was "the greatest honor in all the world." Verkolye painted his portrait — still extant — in which he is shown with his diploma. In all simplicity he asked a friend if he now should appear self-effacing in the presence of a doctor of medicine?

Picture this large-boned man, just passed fifty, stooping over a little table. All around the wall are cases in which there are the lenses that have made him famous. Then there are rows of microscopes with specimens in position so that he may examine them whenever the fancy strikes him. Imagine him examining an infinitely

small bit of stuff on the end of a needle. His daughter Maria enters.

"Father, there is a young Irish doctor who would like to see you."

"What does he want? A doctor! What I think of some of these doctors! I suppose he wants to see my marvelous microscopes."

"He is a handsome young man, father."

"What difference does that make, Maria? I can't have my time taken up showing these things to every leech who happens to stop in Delft. These microscopes are mine. Why don't they grind lenses for themselves? Does he have a letter of introduction?"

"Yes, he says he is representing the Royal Society."

"The Royal Society, eh? That's different. Tell him to come right in."

The conversation soon turns to be the subject of microscopes.

"I was wondering if I might have the pleasure of seeing through some of your marvelous lenses."

"Certainly, most certainly. Here you may see the cells of wood."

"Marvelous," exclaimed the doctor.

"And through this glass, doctor, you may study the sting of the bee."

The doctor examined it carefully. All the while Leeuwenhoek kept his hand upon the instrument.

"Remarkable, remarkable!" exclaimed the doctor.

"And here is another through which you may examine one of my own hairs."

"Very curious, indeed," commented the doctor. "But you have other lenses more powerful than these. I should like to see the little animals about which you

have written so that I can convince some of the more skeptical members of the society when I return to England."

"So there are skeptics still in the learned society of scholars?" the janitor said in a melancholy tone. "It would gratify me very much, if I could show you the instruments through which I study the little animals—thousands of them in an inconceivably small bit of water—but I can't do that. If I were to let you look through my best lenses, you would come to know as much as I know. This is the only reward I have for my pains in searching out these mysteries of nature."

The doctor was embarrassed. He listened, however, with great attention, but in his mind he was saying to himself:

"A man, doubtless of great native ability, though he knows no languages. How he trusts his own thoughts! What extravagances he utters because he does not know the progress that scientists in other countries have made."

Later on in the year, a person far more illustrious than the Irish doctor visited Delft. Word was sent to the Leeuwenhoek home that the Landgrave of Hesse would honor him with his presence. Again we can picture Maria, all aflutter, entering the room where her father was writing one of his long communications to the Royal Society.

"The Landgrave of Hesse is coming to see you, father!"

"The Landgrave of Hesse? A German. I hate Germans! I suppose he wants to see through my microscopes. I can't imagine a landgrave interested in the secrets of nature."

"Shall I show him in when he arrives, father?"

"I suppose. The landgrave interested in science. . . bah!"

Again Anton showed a few specimens that he kept in readiness for the inspection of visitors—the cells in wood, the sting of a bee, a hair. As he exhibited his lenses, he held them in his own hand, fearing that the landgrave might pocket one. From the corner of his eye he watched the landgrave's attendant.

"I should like to see," said the landgrave, "through one of those more powerful instruments you have."

"I'm sorry, excellency, but I cannot let you see through those. Nobody uses those except myself. I keep them locked. I don't trust people—Germans in particular."

"Indeed! Then I'll buy several of your best. What price must you have for your microscopia?"

Anton smiled in a superior way. "You must surely know, excellency, that I never sell any of these instruments or give any to anybody. Nor do I intend to do so. If I did, I would be everybody's slave."

"But how would you be a slave," asked the puzzled landgrave, "if I gave you a generous price for your instruments?"

"I'm sorry, but I sell nothing. I need all these instruments. Go to the lens-grinders. I don't trust people—Germans in particular."

When George III expressed his desire to see the planet Uranus, Herschel packed up his seven-foot telescope and waited at court until the king was ready to observe the newly discovered planet, but illustrious rulers who wanted to see through Leeuwenhoek's microscopes came to him. Some little concession was made to Peter the

Great of Russia, when the janitor went to meet him on a barge outside of Delft where they conversed familiarly for two hours. Dukes and princes might come and go, but none ever peered through his very best lenses. Of the hundreds of lenses he had, he gave away only two — and those to Queen Mary of England. He resolutely refused the Royal Society's request for instructions as to how he built his instruments, though by his will the society received twenty-six of the less powerful sort after his death.

Leeuwenhoek felt perfectly justified in not permitting anybody to look through his best microscopes. If men wanted to see what he saw in his microscopes, nothing was to prevent their buying lenses or making them themselves. Leeuwenhoek might well chuckle while suggesting that they make their own instruments. He knew what patience a man had to have in order to grind and polish lenses until they were entirely satisfactory, and then mount them properly. That was not learned in a single day.

There would be a lot of glass spoiled before they would make a satisfactory instrument. And they would lack the patience to study what they might see under the microscope. No, these curiosity seekers must not be allowed to look through his lenses. Probably they would not see what was there anyway. They might even contradict him, and, if there was anything in the world he could not stand, it was contradiction. If they wanted to know what he saw, let them read his many letters to the Royal Society.

But those who had read his letters were still more curious. Men of education noted that the style was naïve, garrulous and unliterary, but these faults were in-

significant when they considered the contents of these communications. The following quotation furnishes a splendid instance of his style and substance. It is from his communication on bacteria in the mouth, the first chapter in the history of oral hygiene.

'Tis my wont of a morning to rub my teeth with salt, and then swill my mouth out with water; and often, after eating, to clean my back teeth with a toothpick, as well as rubbing them hard with a cloth: wherefore my teeth, back and front, remain as clean and white as falleth to the lot of few men of my years, and my gums (no matter how hard the salt be that I rub them with) never start bleeding. Yet notwithstanding, my teeth are not so cleaned thereby, but what there sticketh or groweth between some of my front ones and my grinders (whenever I inspected them with a magnifying mirror), a little white matter, which is as thick as if 'twere batter. On examining this, I judged (albeit I could discern nought a-moving in it) that there yet were living animalcules therein. I have therefore mixed it, at divers times with clean rain-water (in which there were no animalcules), and also with spittle, that I took out of my mouth, after ridding it of airbubbles (lest the bubbles should make any motion in the spittle): and I then most always saw, with great wonder, that in the said matter there were many very little living animalcules, very prettily a-moving. . . These had a very strong and swift motion, and shot through the water (or spittle) like a pike does through water. These were most always few in number.

The second sort . . . spun round like a top: and these were far more in number.

To the third sort I could assign no figure: for at times they seemed to be oblong, while anon they looked perfectly round. . . They went ahead so nimbly, and hovered so together, that you might imagine them to be a big swarm of gnats or flies, flying in and out among one another. These last seemed to me e'en as if there were, in my judg-

ment, several thousand of 'em in an amount of water or spittle (mixed with the matter aforesaid) no bigger than a sand-grain; albeit there were quite nine parts of water, or spittle, to one part of the matter that I took from betwixt my front teeth, or my grinders.

I have had several gentlewomen in my house, who were keen on seeing the little eels in vinegar; but some of 'em were so disgusted at the spectacle, that they vowed they'd ne'er use vinegar again. But what if one should tell such people in future that there are more animals living in the scum on the teeth in a man's mouth, than there are men in a whole kingdom? especially in those who don't ever clean their teeth, whereby such a stench comes from the mouth of many of 'em, that you can scarce bear to talk to them; which is called by many people "having a stinking breath," though in sooth 'tis most always a stinking *mouth*. For my part I judge, from myself (howbeit I clean my mouth like I've already said), that all the people living in our United Netherlands are not as many as the living animals that I carry in my own mouth this very day: for I noticed one of my back teeth, up against the gum, was coated with the said matter for about the width of a horse-hair, where, to all appearances, it had not been scoured by the salt for a few days; and there were such an enormous number of living animalcules here, that I imagined I could see a good 1000 of 'em in a quantity of this material that was no bigger than a hundredth part of a sand-grain.

But perhaps this condition did not exist in the mouths of others, he thought. In truly scientific fashion he made other examinations; in one of these cases he noted the antiseptic qualities of alcohol.

I have also taken the spittle, and the white matter that was lodged upon and betwixt the teeth, from an old man who makes a practice of drinking brandy every morning, and wine and tobacco in the afternoon; wondering whether the animalcules, with such continual boozing, could e'en

remain alive. I judged that this man, because his teeth were so uncommon foul, never washed his mouth. So I asked him, and got for an answer; 'Never in my life with water, but it gets a good swill with wine or brandy every day!' Yet I couldn't find anything beyond the ordinary in his spittle. I also mixed his spit with the stuff that coated his front teeth, but could make out nothing in it save very few of the least sort of living animalcules herinbefore described time and again. But in the stuff I have hauled out from between his front teeth (for the old chap hadn't a back tooth in his head), I made out many more little animalcules, comprising two of the littlest sort.

While many professionals in universities were paging the superstitions of Galen and repeating them to students as the inspired medical wisdom of the ages, an amateur had leaped two centuries ahead of his time to the day of Koch and Pasteur.

Four years before the birth of Leeuwenhoek, an English physician had discovered the truth about the circulation of the blood. His idea did not take hold at once. Old Galen's doctrine had been approved teaching in the schools for fourteen centuries, and it was not to be upset in a moment by any young upstart of an English doctor. What was this new babble about the heart's being the center of the blood system? we can imagine the traditional school inquiring. Absurd surely! Who was Harvey to oppose the great Galen? Hadn't Galen clearly stated that the liver was the center of the blood system and that blood oozed from it to every part of the body, that the veins contained blood and the arteries air, that the blood was cooled by the lungs? The world couldn't be wrong for so many centuries.

But Harvey proved that Galen's theory was absurd,

and that the doctrine taught for so long was nonsense. The English physician came to his conclusions without a microscope. It was left for Leeuwenhoek to observe the blood actually in circulation.

Old Anton found some frog eggs and brought them home to be examined under his microscopes. As soon as the eggs were hatched, he began to observe the tadpoles in every imaginable way. When the tadpole was eight or ten days old, he saw something small inside it that moved continuously. The liquid that was driven out of this little throbbing part began to take on a red color. Then putting the tadpole, head first, into a tube, he focused his instrument on its tail. A look of amazement spread over his face.

"This surpasses all the things I have seen in my life," he cried. The blood was being forced from the middle to the surface of the tail through vessels of hair-like fineness, which were bent back in a curve to carry the blood to the interior of the tail and then to the heart. He began to count very slowly. "More than fifty circulations in that tiny tail," he exclaimed.

At last he saw the end of a problem that had vexed him for many years. He did not, however, regard his researches as completed. He must look at this many more times and examine other like animals to be certain of his conclusions. Then he put a very small minnow, head first, into a tube and observed its tail. Again his microscope told the same story. The blood passed from the arteries through the capillaries into the veins. What Harvey had reasoned out, Leeuwenhoek had seen with his eyes. He wrote a long letter to the Royal Society about his studies of the circulation of the blood but told the fellows of the academy that he was not yet content.

He would examine the circulation of the blood in other animals to discover if the process had universal application.

But this doctrine was so amazing. Perhaps even the learned members of the Royal Society might not believe it. Being of a suspicious nature himself, he asked men of unquestioned integrity—an ambassador to England and a noted professor of anatomy—to certify to the truth of his observations. If the world would not believe Anton van Leeuwenhoek, a janitor, it must believe an ambassador and a professor.

Many of the criticisms that professional scientists make of amateurs may be made of Leeuwenhoek. What others were doing in his field of research did not much interest him. First of all, he could know little about their work, since he read nothing but Dutch, then regarded as the language of illiterate fisherfolk. But he did not care what others were doing. He was consulting his own pleasure and not the good of the world when he made his investigations, and he often stumbled into his discoveries by accident. His letters to the Royal Society are filled with ramblings that are often senile, observations that are often childish.

Leeuwenhoek's career is in strong contrast to that of the modern scientist, who, when he discovers something of benefit to humanity, is generally willing to share his secret. Perhaps if he had been more generous in his discoveries, he might have shortened the long fight that man was to wage with his deadliest enemies—germs. Certainly he made very splendid microscopes, but it was probably his technique in using them that made his reports so excellent, possibly a special method of throwing light upon the object he was examining. At any rate

the secrets of making and using his excellent microscopes went with him to his grave. He never knew that he was committing a crime against humanity. He never realized the deadly importance of his secrets. Like a small boy he maintained that this was his peep show. He would tell you what he saw, but let you see for yourself—never. No! not for money either.

“No money,” wrote this amateur when close to ninety, “could ever have driven me to make discoveries, and I’m only working out as ’twere an impulse that was borne in me, and I imagine I never meet with any other people who would spend so much time and work in searching into the things of Nature.”

A friend of mine, whose mother’s family has lived for centuries in Delft where the family tomb in the Old Church is beside Leeuwenhoek’s, tells me that in his youth he and his fellows often passed by the tomb of Leeuwenhoek without a second’s thought, and went over to the tomb of a great warrior. In his mind the martial glory of these heroes was then something to wonder at. A lifelong interest in science has taught him to see far more splendor in the achievements of the untutored Dutchman’s long fight to wrest from nature her secrets than in the exploits of generals who led armies to great battles.

VIII
A SCIENTIST BATTLES POVERTY
JEAN HENRI FABRE

“Yes, ignorance may have its advantages; the new is found far from the beaten track. One of my most illustrious masters, little suspecting the lesson he was giving me, taught me that some time ago.” —*Jean Henri Fabre*.

VIII

A SCIENTIST BATTLES POVERTY

JEAN HENRI FABRE

IF, after considering Leeuwenhoek and his "little beasties," we unroll nature's scroll further, we come upon the insect world of Jean Henri Fabre. One could compare these two men at length. Both finished their schooling at a very early age and, self-tutored, rose to distinction by tireless research, lasting from early life to beyond ninety. Leeuwenhoek wrote the accounts of his discoveries in a simple, garrulous style, often introducing matters entirely irrelevant to material he was describing. Fabre avoided the learned terminology of his insects and often humanized his theme by writing of them as if they were human, introducing all the while those biographical notes that have made his volumes so personal.

To one reading his intimate pictures of their lives it seems that these insects are mighty heroes engaged in enterprises that are being told in epic style. He heroized the insect world, and for this reason Victor Hugo called him "The Insects' Homer." Neither Leeuwenhoek nor Fabre was interested in what the rest of the world was doing in the same field. Fabre admitted that he read the opinions of others very little; his library filled only a few shelves. His great book was nature, whose leaves he turned over for hours without experiencing the least weariness or boredom. He attempted to justify this attitude :

I have made it a rule to adopt the method of ignorance in my investigation of the instincts. I read very little. Instead of turning over the leaves of books, an expensive method which is not within my means, instead of consulting others, I set myself obstinately face to face with my subject until I contrive to make it speak. I know nothing. So much the better; my interrogation will be all the freer, today tending in one direction, tomorrow in another, according to the information acquired. And if by chance I do open a book, I am careful to leave a section of my mind wide open to doubt.

Fabre might have been a professional scientist, teaching in a noted university, if he had not been so poor. But poverty stood by him like an evil angel all through his life. He was born of poor parents in Provence. His father tired of the toil of a peasant's life and decided to seek his fortune by opening a café in the city. But poverty stalked behind them wherever they went.

It was hardly to be expected that Jean's education would make much progress under these circumstances. His elementary training had been received in a wretched shack, used at different periods to shelter men, chickens and pigs. By one way or another, his education progressed to the Latin poet Virgil. Then disaster overtook the family, and he was forced to leave school to earn the bare necessities of life at jobs as varied as selling lemons and laboring on the roads. He despaired.

After a time the clouds lifted. In competition for a scholarship in the normal school at Avignon, his name led all the rest. After a time his teachers at the school thought that he was not making the best of his opportunities, and he did not rouse himself from his lethargy until he was charged with idleness. The truth was that he was not idle. Rather he was preoccupied with the

sting of the wasp or the fruit of the oleander. Although his teachers were quite uncomplimentary about his standing, Jean was not lacking in diligence, even though he had failed to conform to the standard pattern.

With about the equivalent of an American high-school training, young Fabre began to teach at Carpentras at a salary of about one hundred and forty dollars for the entire school year. He was dissatisfied and hated the place generously. He told himself that he must get out of this swamp by some means or other. As he saw it, the only means of ascent was through the study of the physical sciences and mathematics. If he would learn specified material in these fields, he could present himself for examination and thus receive his degree without attending a university.

He began to instruct himself by instructing others. With the most primitive apparatus he taught himself and his students chemistry. He collected oxygen for the first time in the presence of his class. He learned algebra by instructing another. A trustful student came to him and said that he must know something of that subject to compete in an examination. Would he teach him enough? Fabre did not know the first principles of the subject, but he also knew that he must not confess his ignorance too frequently, if he were to succeed in his profession. If he could only get a text-book on the subject, he was sure he could digest it without a teacher. But the only person who would have such a book was a fellow teacher much older than himself.

Fabre knew that it would be of no use to ask him for the loan of the book. The only safe way was to remove it from the professor's sanctum. This could easily be done, for the keys to the rooms were all alike. With a

rapid heart he approached the professor's door, used his own key, lifted the algebra text from the shelf, and returned quickly to his own room. He read through the book as though he were reading a tale of adventure. He gave the boy the requisite lessons and returned it to the shelf from which it had never been missed. It is hardly necessary to note that, if Fabre had been caught at this low business, the world might have been poorer by one scientist.

Another one of his colleagues was an ex-soldier, who had on several occasions failed to pass the examinations for the baccalaureate in mathematics. This man patronizingly undertook to teach Fabre so that he, too, might take these examinations. Before they had worked together long, Fabre was doing the teaching. Both presented themselves for examination. Both passed. Fabre continued on since he was ambitious to receive the licentiate in the same way. Here again he was successful.

Now surely, he thought, he would outdistance poverty. A good appointment must now come as a regard of this industry. But no offer came. Meanwhile his expenses had increased. He had married at the age of twenty-one, and his sorrows in life had begun in real earnest when his first child died. Though his correspondence at this time breathes resignation at the loss, he was bitter because his ability was not recognized by promotion. He had won his licentiate and was entitled to advancement, as even his superior admitted. Instead he and his wife were forced to lead a hand-to-mouth existence.

It was intolerable. Not only did he receive a trifling salary, but he was obliged to wait for his money long

after it should have been paid. It was maddening. He had his degrees and was made "to conjugate verbs for a pack of brats!" and then, after earning his pay, he had to wait around for it like a beggar. He often determined to resign when the school term expired, but in spite of his threats, he always returned to his gloomy situation after the vacation.

One day, however, an appointment arrived in the mails. He was to teach physics at Ajaccio on the island of Corsica at about three hundred and fifty dollars a year, over twice what he had been receiving. Poverty was lagging behind a little now, though, to be sure, there would still have to be a great deal of economizing. When the family landed at Ajaccio, they knew that things would be much more pleasant here than at Carpentras. This was a wonderful place to study nature. Almost immediately he began making a collection of rare shells, but he had to forbid himself the study of nature. If he became too interested in that, his work in physics would surely suffer.

It was here that the teacher of physics received his first and his only lesson in biology. A professor from the University of Toulouse visited Ajaccio. When he could not find a room, Fabre offered him hospitality, which the professor appreciated at the time. As the polished professor was leaving some such conversation as this must have taken place:

"I want to thank you, Monsieur Fabre, in the name of my colleagues of the University of Toulouse, for the kindness you have shown me and also for the rare varieties of shells you have collected for us. You have been most hospitable to me; believe me, I shall not forget it. If you are ever at Toulouse, be sure to give me the

pleasure of being your host. You have been most hospitable."

"We have done nothing, monsieur. Our home has been honored by the presence of a scientist."

"You are interested in science, aren't you?"

"Yes, but I dare not yield to the temptation to study biology. My work is in physics and mathematics."

"Indeed? Let me give you a first lesson. Let us examine a snail. But we have no scalpel, no dissecting needles. Perhaps we can use the madam's scissors and two ordinary needles, and bring a dish of water."

The young teacher of physics looked on while the great professor dissected a snail and explained its structure to him. The lesson was brief, but intensely interesting. Later in life, when Fabre himself was becoming recognized for his studies of insects, he called on the famous professor. That worthy could recall neither the famous lesson nor the pupil who had shown him so much hospitality.

Before Fabre was long on the island of Corsica, he contracted a fever and was forced to return to France. When he was well, he was given an appointment at a smaller salary at the *lycée* in Avignon. Here he gave twenty years of unstinting service to education, but not once did he receive a raise in pay or rank. His salary remained at three hundred and ten dollars a year, though he later received an additional two hundred and thirty dollars from the city for taking care of the museum. His family now numbered five children.

Nobody ever tried more desperately than Fabre to forge ahead in the teaching profession. He was always working, if not in school, then at some data for a paper. If the people of Avignon would not recognize his ability,

he would call attention to himself by his publications. When he was thirty-two, he contributed an important article on the habits of the cerceris, a hunting wasp, and the cause of the long preservation of the beetles with which it feeds its young. He had dreamed of advancement. And he was recognized. The University of Poitiers invited him to become a member of its faculty, but when he reckoned the cost of moving his large family and discovered that the salary remaining would be less than a dollar a day, he was forced to decline the offer.

He did not realize how futile his ambitions were until some days later when the inspector of schools dropped in to observe his work. After the students had been dismissed, the inspector lingered in the room. Fabre, anxious to exhibit the fruits of his instruction, showed some mathematical drawings to the visitor. They were done exceedingly well. The inspector handled them mechanically and tossed them aside, saying:

"I understand you have ambitions to teach in a university."

"Yes, I should like that."

"Have you any money?" the inspector next asked.

Fabre stiffened a little. People were always talking about money. Then he admitted that he was poor.

"Then," said the inspector, "give up these dreams. The salaries are so small that you would be doomed to live in poverty. Now if you had a private income—I know about your research and your papers, but you would be poorer at a university than you are here. Penury in a frock-coat, monsieur, is a tragedy."

Then it was poverty that was blocking his advance again. If money were necessary for a university post,

he would make it by embarking on a commercial venture. One of the principal industries of the district was the extraction of a dye from the madder root. He would study out a simpler process. Just as he was ready to reap his profits, the slave's hope of freedom vanished. Chemistry produced the dye synthetically.

He had one splendid opportunity within his grasp and he fumbled that. The Minister of Education, Victor Duruy, was aware of the knowledge and teaching ability of this modest, retiring scholar in Avignon. Duruy arranged to have him made a Chevalier of the Legion of Honor. While Fabre would be in Paris, an interview could be arranged with Napoleon III. Perhaps the emperor would engage him as a tutor for his son. When Duruy wrote to Fabre about the proposed honor, the peasant was reluctant to go to the capital, but Duruy, who appreciated the temper of genuine scholars—he himself was the author of a noted history of Rome—ordered him to come.

Fabre was not at all excited by the fact that he was to receive a great honor. He came to Paris, with his old broad-rimmed, black hat and his worn suit. Napoleon chatted with him privately for a while. Fabre had nothing to say, not because he was abashed in the presence of the mighty but because he felt that there was nothing to be said. It was clear to the emperor that such a man as Fabre lacked the social graces, the poise that the instructor of his son must have. Here was the chance that Fabre had wanted for years, but, instead of appearing at his very best, he was dreaming of Avignon. The opportunity had come too late. Already he was definitely set in a way of life and was not to be changed.

Once the interview was over, Fabre was immediately

ready to return home. Duruy was amazed. To come all the distance from Avignon to Paris and then to return without seeing the sights of the capital! Didn't he wish to see the museums for which Paris was noted throughout the world? No, he saw enough of museums in Avignon. He took care of one himself. Besides these things were all dead. He was interested more in things that were alive, even though they were only insects. Moreover this populous center was too confusing for him. He must return to his wife and family.

And so the man who had wanted to go forward in life, with a strange lack of vision, turned his back on the mighty and returned to his tasks in Avignon, where he continued to feel that fate had denied him opportunities. But little did he suspect that trouble was ahead of him even in Avignon.

The political party in power was attempting to secularize education and, as a part of this program, instruction in science was given to girls. Fabre agreed to conduct this work in Avignon. Certain spinsters in the town were sure that there was something scandalous in this new learning. There was grave danger to maidenly morals in this liberation of the female mind. Fabre tells us the story:

You can see how heinous my crime was: I taught those young persons what air and water are; whence the lightning comes and the thunder; by what device our thoughts are transmitted across the seas and continents by means of a metal wire; why fire burns and why we breathe; how a seed puts forth shoots and how a flower blossoms: all eminently hateful things in the eyes of some people, whose feeble eyes are dazzled by the light of day.

The little lamp must be put out as quickly as possible and measures taken to get rid of the officious person who

strove to keep it alight. The scheme was darkly plotted with the old maids who owned my house and who saw the abomination of desolation in these new educational methods.

Fabre had taught science to girls as a part of the anti-clerical program, and, with the return of the clerical faction, his resignation was being sought. He was disgusted, but he did not attempt to fight back. If they wanted his resignation, they might have it. Besides he was weary of teaching for a pittance, weary of this constant wrestling with poverty. If he could only have the leisure to write some elementary manuals in science, he knew that he would earn at least as much as he made at teaching.

After so many years of explaining nature's mysteries to young minds, he had acquired a skill in making them clear and interesting to children. He could never understand why writers of manuals made their books so unnecessarily uninteresting. But he would have to have quite a sum to live before receiving any royalties, and where could he go for a loan? He could not ask Duruy, for he had fallen before the political assaults of the clericals. Fabre turned to John Stuart Mill, with whom he had become acquainted when the latter had taken up residence at Avignon in sight of the grave of his wife. The philosopher gave the teacher a generous loan, and the Fabres with their household effects took the road to Orange.

Eight years passed. His text-books were enjoying considerable success. His debt to Mill was paid, and there was something laid aside. Then all of a sudden the family was moving again. Once more the landlord had his finger in the matter. In front of the Fabre home

were two rows of plane trees. These his thrifty landlord cut down. Fabre, who loved these trees, was exasperated and decided that in the future he would live upon his own acres.

Thanks to the vogue of his manuals, he was able to buy a piece of property near the village of Sérignan. He sang a psalm of delight as he took possession of the place. His struggle with poverty was over; he was independent; his dreams were realized. His desires had been very modest indeed, for the place he had acquired was a wretched piece of land from an agricultural point of view. For his purpose, however, this dried up, unfertile, stony tract was ideal, since it was the rendezvous of many insects he had long desired to study. He was fifty-seven now, an age when most men begin to think of death or retirement. But Fabre's life had only begun. His wife, who had struggled with him all through the years, died shortly after their coming to Sérignan. After mourning for a decent interval, at the age of three score, he married a young woman, who in a short time brought three more Fabres into the world.

Here at Sérignan he set about making those experiments which were to find place in the ten volumes called the *Souvenirs Entomologiques*, written during the next twenty-eight years. Other scientists had typed and filed the classification and description of the insects, but this did not interest him as much as observing them in their natural surroundings and writing the diaries of their private lives. He had the leisure now to lie for hours, sometimes under a blazing sun, observing the habits of ants or wasps, of spiders or beetles or bees, prying into their homes, spoiling their work or teasing them, to note their reactions. To him this prying into

nature's secrets was the most interesting thing in the world.

It was often urged upon Fabre that he write out a theory of the origin of instincts, thus synthesizing much of the analysis that he made through the many years of his life. But he resolutely declined so bold an undertaking, saying that man knows nothing about anything, that he would not presume to sound the depths of the ocean because he had stirred a few grains of sand on the shore. Fabre had seen many theories come and go in his long life, and he did not covet the mantle of the prophet.

"Theoretical rubbish heaps up," he wrote, "and the truth ever escapes us." Yet in the matter of instincts, he lent all the weight of his authority to support the view that there is a distinct line of cleavage between instinct in animals and intelligence in man, thus opposing the view that instinct is simply a lower level of intelligence. In the long range of his experiments, he seems to have found nothing that disturbed him in this conclusion.

He was one of the really great scientists who opposed the evolutionary theory advanced by Darwin. Although Darwin referred to him in the *Origin of Species* as "the inimitable observer," and in personal correspondence suggested certain experiments with mason bees, which Fabre painstakingly carried out, Fabre never gave Darwin's book a hearing. He began it, but did not long continue, claiming that it bored him.

At the age of eighty-four, he ceased publishing. Again the spectre of poverty appeared. The income from his texts had fallen off, and the popular studies he had written at Sérignan had not yielded much in the way of royalty. In desperation the poet of science

wrote to his friend, the famous Provençal poet, Mistral, that he would appreciate finding a buyer for certain paintings of mushrooms that he had made long ago.

The poet was touched by the destitution of his friend. A great scientist in want! He would tell the world about this neglect. The response to Mistral's plea was immediate and generous. The government gave him a pension, defending its neglect by stating that his condition had been known, but that Fabre's sensitiveness was so great that the matter required extreme delicacy. From neglect he now passed into the glare of publicity. He complained of the excessive attention he was receiving. By a curious irony, the General Council of Vaucluse voted him scientific instruments, when his work was over.

Fabre was capable and he knew it. It was the lack of early recognition, coupled with the constant struggle against poverty, that saddened a great part of his life. He was constantly letting remarks about his disappointment escape him. "I have known some," he wrote, "who, having achieved skill in turning somersaults, have prospered better than the thinker." Certainly he was not given the recognition that he deserved at a time when he could make use of it, a recognition that was frequently conceded to less capable men, who studied the methods of getting on.

Men with half his intelligence realized that advancement comes not solely on the basis of ability, but through the quality of one's personality, through valuable contacts, carefully fostered. Fabre paid no attention to "selling himself." He never seemed to relax, had no time for frivolity. Not only this, but he seemed to pay little attention to the social graces which no one who

would rise can afford to neglect. He had no time for social calls, and absolutely refused to change his wide-rimmed black hat for the more formal dress required on occasions. People came to regard him as queer.

But if earlier in his life Fabre had received an appointment in a university as a professional entomologist, with no worry about securing a means of livelihood, his name probably would never have crossed the borders of France.

IX
FROM INDIGO TO EXCAVATION
HEINRICH SCHLIEMANN

“Schliemann is an outstanding example of my repeated contention that the enlightened amateur beats the solid expert every time.”—*Emil Ludwig*.

IX
FROM INDIGO TO EXCAVATION
HEINRICH SCHLIEMANN

NO MAN ever set the compass of his life and proceeded with more directness to the goal of his ambition than Heinrich Schliemann. Though he journeyed much over land and sea he always approached nearer to the vision he had in his mind from youth.

What was this vision? It was the ancient city of Troy. He had his father to thank for the inspiration, for when Heinrich was a little fellow, his father took him upon his knee and told him the age-old story of Homer. How Paris had stolen Helen, and Menelaus and Agamemnon had set sail from Greece to bring her home again. How the war lasted for ten years, how Achilles sulked in his tent, and Ulysses outwitted the Trojans by means of the wooden horse.

"But where is Troy now, father?" he would ask. "Nobody is sure, my boy. Some of the teachers say one thing and some another. This happened a long, long time ago. The city was burned, the sand storms covered it over, and men have forgotten where it was."

The tale laid hold of the imagination of the boy. The father was pleased at this early interest in things classic and gave him for Christmas a book in which the events of the great epic of Homer were illustrated. Whatever unfavorable criticism may be written of his father—and considerable has been written, for he was sensual, financially irresponsible and irascible—he must be given

credit for lighting a fire in the boy's mind which was never extinguished. At eleven he was packed off to an uncle's home where he studied some Latin. As a Christmas gift, the son sent the father a brief Latin essay on the fall of Troy.

But this relationship between father and son did not move on as pleasantly as these early incidents seem to indicate. At fourteen the boy had left home to work for a grocer. The vision of the Troy that he had promised himself he would discover must have been somewhat dimmed while he worked from dawn to dusk at tasks that were hard and boring. His ambitions were somewhat revived when he heard a drunken scholar recite a hundred lines of Homer. "What a beautiful language!" Heinrich exclaimed. He seems to have had no scruple in bribing the minstrel with drink to repeat the performance several times.

One day Schliemann was missed at the grocer's counter. His days of selling a pound of this or a pint of that were over. Later his memory failed him when he tried to remember why it was he left his sixteen-hour-a-day job. Perhaps there were several reasons. He had spat blood while lifting a heavy cask. Then, too, he was not getting on well with his father—a circumstance hardly to be wondered at since the latter was making a fool of himself to the disgust of his son. Perhaps it was his determination to show his father that he could make his own mark in the world. But there was also a love affair that had been broken off by the girl's parents, who disapproved of Minna's betrothal to a poor son of a reprobate minister. All these factors may have contributed to young Schliemann's resolution. He might not be strong physically, but his day would come, and

when it did he would make so much money that they would all be glad to say, "I knew him when —"

If it had not been for these adversities, he might have turned into a vagabond, but opposition only made him more determined. He would show the world.

Being out of a job, he went to school and studied book-keeping for nearly a year. Then he was off to Hamburg to find work. But his lack of experience and ill health hindered him at every turn. In desperation he signed up as a cabin boy on a brig bound for South America. When the ship was off the coast of Holland, it capsized. For four hours he held on to a cask in the raging sea until he was tossed up onto the Dutch shore. This experience over, he decided to live the prosaic life of a landlubber.

His good fortune now begins, never to desert him. At Amsterdam where the inspired amateurs, Leeuwenhoek and Spinoza, learned their trades, he eventually found work. He was only an office boy, but what an office boy! When he was sent out on messages he spent his time declining nouns and conjugating verbs in foreign languages, stealthily reading some passage in a foreign tongue or translating sentences he would need when he, too, would be a merchant. Languages would multiply his personality, increase his opportunities. He knew that he must first improve his knowledge of his mother tongue, and he took lessons in German. His interest in English led him to attend services in an English church where he slowly repeated to himself the words spoken by the preacher. His memory grew sharper every day. In his first year in Amsterdam he studied French as well as English, in his second year, Spanish, Italian, and Portuguese.

A young man of such talents and ambition could not long remain unnoticed. At twenty-two he was employed by an importing firm and straightway proceeded to climb to the top over his seniors in service. When he was two years with his company, he was made its representative in St. Petersburg.

This new appointment involved the necessity of learning Russian. It wouldn't be hard to learn the language, but where in Amsterdam could he find an instructor? He unearthed a Russian book and began. Even if he had no tutor, he must enjoy the flattery of a listener. A Jew, who knew nothing about the language, was glad to lend a patient ear for two hours each evening at four francs a week. Perhaps Schliemann didn't have the correct accent, but what of it? He kept on shouting in the hope that this might atone for faults of grammar.

If he had only known it, he might have saved the francs he paid his ignorant listener, for the circle of his audience was wider than he imagined. People in the same house rebelled at this ranting in Russian. The landlord asked him to continue his studies elsewhere. He did so, but again he was ejected. There was nothing thin-skinned about Schliemann. This was his method, and he would stay with it. When merchants from Russia appeared some weeks later, he was able to converse with them.

When Maria in *Twelfth Night* berates Aguecheek as a fool, Sir Toby springs to his friend's defense. "Fie, that you'll say so! he . . . speaks three or four languages word for word without book . . ." If so much learning excited Sir Toby's admiration, his superlatives would die of exhaustion should he try to recommend Schliemann's ability at languages. By the time he was

twenty-five, he could speak twenty languages "word for word without book." Later he added others until the number reached thirty-five.

How did he do it? First of all he was no pail to be filled by the teacher's toil. Instead of letting the instructor conduct the lesson in the usual method, he began by asking questions. Soon he had the several hundred words necessary for connected narrative. Then he wrote little compositions which his teacher corrected. This material he memorized, shouting it aloud because he intended to speak it. In fact it was the utility of language study that spurred him on. On every page he memorized he saw future customers rising before him. Their orders might repay him many times over for his trouble. Later, when learning languages became a passion with him—and the more of them he learned the easier was the next one—he would study some he would never use, but that was after he was financially independent.

Once in Russia, the agent found that he could make much more money if he went into business for himself. He prospered at selling indigo, and the vision of his ancient Troy seemed to grow brighter. But he must not dwell on it. A fortune must be made before undertaking so expensive a project. Gold must be piled up before the gold of a buried city could be reached. With intense application he set to work. That did not mean, of course, that he must chain himself to one place. St. Petersburg was his address for the next twenty years, during which time his *wanderlust* drove him to many parts of the world, once even around it.

He was doing well in Russia when word reached him that his brother Louis, two years his junior, had died of

typhus in the gold fields of California. Heinrich had tried to do something for his brother by teaching him several languages and later offering him several hundred dollars to set up in business. But Louis had scornfully refused so slight a sum. He wanted to be taken into business with Heinrich and, to force his hand, wrote a letter in which he dramatically threatened to take his own life, signing the statement with his blood. Promptly Heinrich sent his brother in Holland enough money to return to Germany. With some cash in hand the brother decided to postpone his suicide and sailed for America just when the gold rush to California was in progress. He had Heinrich's gift for making money and in two years was worth thirty thousand dollars.

When Heinrich heard of his brother's wealth, his respect for him increased immeasurably. Then word came of the brother's death. Schliemann was interested in the wealth that Louis had left. He had helped his brother and he felt that no one could challenge his right to inherit the fortune. He decided to go to California. When Heinrich made his first voyage to sea, eight years prior to his brother's death, he was penniless. This time he went not as a cabin boy but as a prosperous merchant, though not yet thirty. But he must have felt himself a re-incarnated Jonah when eighteen hundred miles out of Liverpool the engine of the ship broke down. A sail was fitted up. It was over two weeks before the ship put in at an Irish port.

Schliemann was vexed but not vanquished. Again he booked passage, and this time the god of the sea relented. When he presented himself as claimant of his brother's fortune, he discovered that Louis' partner had absconded with the money. He could sue, but he was

too nervous a man to become involved in the law's delay and too prudent to risk a fruitless session in the courts. Instead of bemoaning his loss, he opened a bank in California where he bought gold in eight languages. He stayed in America a year and a half during which he contracted fever twice and doubled the thirty-five thousand dollars he had at the outset. The vision of his buried Troy now seemed brighter.

Returning to Russia he found, like Midas, that everything he touched turned to gold. Every year showed a great increase in his income. In one year he doubled his fortune. But in spite of increasing wealth, he claimed to be unhappy. The truth was that he had been luckless in love. Once he had acquired means, he had decided to renew his suit for Minna, a girl he had known at home. To his sorrow he learned that she had married several days before hearing from him. This wound healed quickly. In a year he was raving of the divinity of one Sophie, but his pride was hurt when a soldier of fine physique was preferred to him. Then he was distracted by Katharina. He married her to his sorrow. In ten years there were three children, and Schliemann took it amiss when informed by his wife that she would have no more.

His wife didn't seem to understand him, a difficult task to be sure. They did not waste much sympathy on each other. With him the making of money had become an obsession; he was constantly preoccupied with business matters. If the interest of the moment was not business, then it was a new language, which he was learning by his noisy method. Heinrich was internationally minded; Katharina was quite satisfied with Russia and rebelled when he wanted her to follow

him to foreign cities. To her nothing was so dull, stupid and wasteful as going to Asia Minor to excavate a buried city. Most certainly she wasn't going. She was a Russian; in Russia she would live and die.

Though he was unfortunate in love, his business contacts continued to be more and more successful. Luck was always on his side. On one occasion, during the Crimean War, the docks at Memel were totally destroyed by fire. Crushed, he told himself that he would have to start again at the very bottom to rebuild his fortune, for practically all his wealth was tied up in materials that had just arrived. Later, word came that his merchandise alone had escaped. His goods had arrived when the warehouses were overstocked and had to be stored elsewhere. Because the Crimean War was in progress, prices of war materials soared at the time. He disposed of his goods at a great profit and later piously wrote in his memoirs, "Divine providence often protected me in the most marvelous manner, and more than once."

Heinrich had postponed the study of Greek to his middle thirties because he knew that Greek literature would interest him so much that his work would be neglected. Now that his capital insured a large income, he began to talk of retiring to take up his life ambition, the location of buried cities. He began Greek as he began everything. Soon he was forming his theories about the location of ancient sites. Business began to interfere with his study. He attempted to retire when he was thirty-six, but a law suit brought him back, and he was not able to free himself from the shackles of business until six years later.

He ended his old life and began the new by making

a journey around the world. With the instincts of a business man, he immediately filed his report to the world in a book on China and Japan. Arriving in the United States, he felt perfectly at home. California was admitted to the Union in 1850. Since Schliemann had been in the state at the time, he became a citizen of the United States by simply declaring his presence. He was not a man to slip through the country in disguise. On his former visit, he had called on President Fillmore, chatted with him for an hour and a half and met his family. Now he called to see President Johnson. He bought stock in various railroads in America and rode over the lines with the feeling of a director. He was taking no broker's word for anything; most men in his opinion were rogues anyway.

Paris now became his address. To his Russian wife he sent all kinds of bribes. He wrote of his palatial quarters—the theatre, luxuries, the education of their children—but she was cold to all these promises. When pleading was of no avail, he stormed. He would cut her off penniless, leave the children barely enough for their education and divorce her.

Meanwhile he kept up his intensive studies. Greece and Troy were visited. Promptly he issued his report in a work outlining his theories. Professionals, of course, quarrelled with the conclusions of this amateur. His positive spirit always made enemies, though his ability was recognized by the University of Rostock, which conferred on him the Doctorate of Philosophy.

Schliemann believed so whole-heartedly in his theories that he determined to spend money to prove them. But first he must remarry, and before that there must be a divorce from his chilly spouse in cold Russia. For this

divorce he would go to the United States. About this time the divorce laws of the State of Indiana were undergoing revision. He had enough money, it appears, to retard the revision. Perhaps it was to avoid the impression that he was in Indianapolis only to divorce his wife that he bought a house and an interest in a starch business there. Once divorced, he wrote to a friend in Greece that he was again free. Would he pick a Greek wife for him? The reply was immediate. Nothing could be easier. In fact his friend would not be obliged to go outside of his own relationship to find a suitable girl.

When this strange wooer appeared in Athens the word spread on all sides that the wealthy German had come! Too bad he was so old—surely thirty years older than Sophia—but he had money and that was something a good Greek girl should consider. Quickly she was dressed in the finest clothes to be found. She must look her best for this was the chance of a lifetime.

Schliemann's swift glance saw that the girl of sixteen had undeniable charm. The parents noting this were highly pleased. It was a cautious business. Schliemann, the merchant, liked the bargain, but he thought that perhaps after all there should be a little romance in these new espousals. He inadvertently asked the girl why she was marrying him. With a childlike simplicity she told him the truth; he was wealthy, and, besides, her parents had told her this was the right thing to do.

This unexpected frankness chilled his ardor. He was a merchant, but he drew the lines at buying a wife. Did her parents think a wife was a slave? He would look around for himself. One hundred and fifty candidates quickly presented their credentials, but the business

of selecting a wife from such a multitude was too nerve-racking a task for his impetuous nature. Meanwhile Sophia's relatives were active; the misunderstanding was cleared up.

Despite this unromantic method of wooing a wife, the marriage turned out happily, doubtless because of the humble nature of the bride. She did her best to meet Heinrich's ideal of what a wife should be. She adored her husband as a god and yielded to him in everything, even to the style of furniture in her own room.

Now he was ready to excavate the Troy he had dreamed of discovering since his father held him on his knee and told him its story. He appeared in the Troad with his Homer in hand. The epic would help him identify the spot of the city of Priam. Some scholars were amused to think that anyone should believe Troy ever existed, to say nothing of consulting the poems in order to settle the location of the city. Most of the scholars who believed that there was a Troy held that it was near the modern Bunarbashi.

When the German merchant appeared on the scene, he was sceptical. He paged his Homer and, trusting entirely in the text, said that this was not the spot. The Troy of Homer was near the sea, but this location, though ideal for a citadel, was too far inland, a journey of several hours. The warriors couldn't have crossed many times from the ships to the walls within the course of a single day, if this was the site of the citadel. This place was too far from the coast. Moreover it was too steep toward the river to permit Achilles to pursue Hector around the walls three times.

Calvert, the American consul at the Dardanelles, is entitled to the credit of showing Schliemann the site

near the modern Hissarlik, only three miles from the sea, where Troy was eventually excavated.

For a score of years he worked at Troy intermittently. The first two campaigns were not very encouraging. Scholars paid little attention to his project. But during his campaign in the third year, on one never to be forgotten day in the annals of archaeology, the Schliemanns noted that a pick had pierced the top of a chest. The men were dismissed. Doctor Schliemann had suddenly remembered that this was his birthday.

When the rejoicing workmen had gone, the Schliemanns quickly got to the contents of the chest. "Ah!" said Schliemann, "this was Priam's treasure. Look at these necklaces, jewels, ornaments of all kinds. That golden goblet must weigh over a pound. Hold your shawl, Sophia, and we will fill it before anyone discovers us. The Turks will never see these things. What appreciation have they of such rare ornaments? The idea of dividing this treasure!"

"Isn't it wonderful?" Sophia exclaimed.

"You will wear the beautiful ornaments worn by Helen of Troy, my dear. These treasures are priceless."

The hoard of about eight thousand seven hundred gold objects was smuggled to Greece. Their joy was too great to be concealed. Upon hearing that Schliemann had failed to surrender half of what he had found, the Turks ruled that he must pay ten thousand francs. Always theatrical, he paid five times the amount and promptly wrote a book on these Trojan antiquities.

For his dishonesty with the Turks, he paid dearly. When he later sought permission to continue his excavations, there were all kinds of obstacles put in his way.

After a great deal of red tape, the privilege of digging was granted. When he came to Dardanelles, the Governor of the Troad kept him cooling his heels for two months on the pretext that the permit must be confirmed. Schliemann raged. When he was allowed to proceed with his work, an official was sent along to take care of Turkish interests. This man harried Schliemann so much that he decided in his anger to give up the work—at least for a time. But first he would tell the world in a letter to the *London Times* what he thought of the Governor of the Troad. The Governor was transferred.

He now crossed over to Greece and began excavating at Mycenae. But his deception of the Turks did not enhance his reputation among the Greeks. Here too he was hedged in with the restrictions of officials. He was allowed to dig under certain conditions, but he could retain nothing of what he discovered. He was forced to content himself with the exclusive privilege of publishing for a period of three years whatever he might discover. Again the professionals said that he would find nothing, for he was excavating in the wrong place.

This was hardly a bargain from a business man's point of view, considering the expense to which he went in bringing these records of antiquity to light. He employed one hundred and twenty-five laborers at a wage of about forty-two cents a day. Not only did he expend money, but he and his wife wore themselves out superintending the work from early morning to dusk, in scorching sun or in a wind constantly blowing dust into their inflamed eyes. But they were amateurs in love with their work and they did not mind the expenses or the weather. In spite of all these annoyances, he

could imagine nothing more interesting than the excavation of such a glorious city where every object revealed a new page of history.

He was, of course, successful, as he knew he would be. Immediately he sent a telegram to George, King of the Greeks:

With extreme joy I announce to Your Majesty that I have discovered the tombs which tradition, finding echo in Pausanias, has designated as the sepulchres of Agamemnon, Cassandra, and Eurymedon, and their comrades, slain during a banquet by Clytemnestra and her lover Aegisthus. . . I have found in the sepulchres immense treasures of archaic objects in pure gold. These treasures are sufficient in themselves to fill a large museum, which will be the most wonderful in the world, and which during the centuries to come, will draw to Greece thousands of strangers from every country. As I work for the pure love of science, I naturally make no pretensions to these treasures, which I give intact to Greece with keen enthusiasm. May God grant that these treasures may become the corner stone of an immense national wealth!

Schliemann was not a man to hide his light under a bushel. His telegram to the king certainly showed little restraint, but he had reason to glory, for his treasure was the greatest that any excavator had ever found. In the five tombs there were many funeral offerings of priceless value—diadems and pendants, bracelets and rings, crosses and vessels, breastplates and masks—all of gold.

Schliemann had difficulty in deciding to what nation he would leave his Trojan treasures. To the Greeks? No! They had heckled him too much while he was slaving to promote the wealth and glory of Greece. To the English? Perhaps. The treasures were in London for a time. Finally he was prevailed upon to give

them to the Berlin Museum. The city in gratitude made him a citizen of Berlin, a rare honor.

From his youth to that day in 1890 when he fell exhausted in the streets of Naples and died among strangers without uttering a word, his life was a constant fever of activity. One might expect that at his age he would be more inclined to stay at home with his wife and their two children, Andromache and Agamemnon. But his restless energy gave him no peace. He wanted to see everything, to know everything. With this temperament went certain faults. He was irascible, blunt, prejudiced. His impetuous nature hurried him to the end of an enterprise.

Since he was primarily interested in Homer, he ruthlessly tossed out everything until he reached the lowest of the nine cities. In his haste he had passed the Troy of Homer, now known as the sixth city, and had gone to the bottom—to the early Aegean civilization, hitherto unknown. Archaeologists have often criticized this haste, but he was a pioneer in archaeology, and the technique of excavation was not worked out at that time. Today the University of Cincinnati is busy sifting the material tossed aside by Schliemann, as he hurried to get to the very bottom of the pile.

But after all his limitations and eccentricities are recited, there still remains a character of generous impulses, a mind of insight and originality.

X

BANKER HISTORIAN

GEORGE GROTE

“It is a coincidence so striking as almost to put the English university system itself on the defensive, that neither Grote nor Gibbon owed anything to Academic training. Gibbon indeed spent fourteen months at Oxford: — ‘the most idle and unprofitable of my whole life.’ George Grote, the son of a London banker, ended his school days at sixteen, when he left Charterhouse. He had been grounded in Latin by a devoted mother at five years, however, and he took with him to the bank little or no mathematics, and an enthusiastic love for metaphysics, classical literature, and history, which proved to be lifelong.” — *The Warner Library*.

X
BANKER HISTORIAN
GEORGE GROTE

DURING the year when Schliemann began his digging at Troy, another business man, turned scholar, was ending a long career in England. This was George Grote, who, though trained in banking, had written a history of Greece in a dozen volumes.

Looking at Schliemann's background, one would hardly prophesy that this merchant would ever startle the learned world. It was equally improbable that Grote would ever distinguish himself in the field of scholarship, for his career had been decided by his father at birth. The Grotes were bankers, and this boy would be a banker, too, just as his father and grandfather had been. Who could believe that the oldest son would ever desire to be anything else? So it was that at the age of sixteen young Grote found himself at a desk in his father's bank.

Grote had sent his son George to be educated at Charterhouse because the headmaster agreed with the Egyptian proverb that a boy's ears are on his back, and he hears when he is flogged. As he sat at his desk in the bank, the recent graduate of Charterhouse could attest to the severity of the discipline maintained there. He could still hear the headmaster saying:

"Master George, I assure you that this matter pains me far more than it does you, but my duty is clear; so is your infraction of the rules of Charterhouse. You admit, then, that you were out of bounds?"

"Yes, sir."

"Where were you?"

"At the tavern, sir. Since tomorrow is our leaving day, I thought you would not take it amiss —"

"Take it amiss! Do you not perceive that your infraction of the discipline is more to be censured since tomorrow is your leaving day? This is an outrageous breach of conduct and, if left unpunished, may become a low precedent in this school. You did well to tell me the truth, for my senses are not so dull as to fail in detecting the odor of spirits on your person. You are more guilty than the others because you organized this brawl."

"But really, sir, we drank but little and sang —"

"And therein your conduct emulated that of the low spirits who frequent such resorts. You will bend, please."

The father had wanted discipline for his boy and in that respect he had made no mistake in choosing Charterhouse. But since the elder Grote had nothing but contempt for the impractical life of the scholar he made a mistake in sending his boy there, for Charterhouse had an entirely classical course of study. The boy was already almost spoiled for business. As he worked with his accounts in the bank, he envied those classmates of his whose parents had permitted them to continue studying, and often dreamed of how much more interesting it would be to turn the pages of Greek authors than those of dull ledgers. His sojourn at Charterhouse awakened in him a fondness for classical learning that was never to pass away. There was, however, a thick vein of common sense in his nature. He kept on at his accounts and spent his leisure with books.

Circumstances in the Grote home seemed to lend themselves to study. The mother, who had been something of a gay belle in her day, had lost much of her interest in hospitality after her marriage. Her sparkle was further dulled by her acceptance of Calvinism. To escape the severity of home life, her husband occasionally went out to drink some ale with friends who were not welcomed by Mrs. Grote. George accompanied his father in this relaxation, but he did not enjoy these drinking bouts. They were a dismal murder of time. He was making friends of a sort different from the cronies to whom his father had introduced him. These were philosophers—important men in their day and still remembered—Ricardo, the elder Mill, and Bentham.

His interest in books was deepened by the unhappy turn of a love affair. He was twenty-one at the time. Harriet Lewin, two years his senior, seemed to him the fairest creature that ever breathed, but he lacked the courage to tell her. Young Grote had to confide in someone. He knew that either his father or mother would frown on such frivolity. Recently he had become very intimate with a reverend gentleman of the district who, being a splendid classical scholar, had helped him in his studies. Grote had the profoundest respect for him and told the divine his feelings toward Miss Lewin. But the reverend gentleman now assumed the role of the villain in the melodrama.

“Miss Lewin’s heart and hand are engaged to another,” he said.

George was crushed. He could never be happy again, he told himself. Life had suddenly lost all its importance. His father saw that his son was going through a crisis and a few questions brought on the con-

fession that he had fallen in love. The elder Grote's ideas on the subject of love had undergone considerable revision since his marriage. Catching his son in a moment of despair, he compelled him to promise never to marry until he would receive parental approval. To George it made no difference what promise he made, since he had lost Harriet.

But Harriet, off on a yachting vacation, heard of the episode, and when she returned, the reverend gentleman was unmasked. The heart and hand of Miss Lewin were not engaged, though the reverend gentleman himself had vainly endeavored for months to compel her to receive his addresses. George was a happy man again. Immediately he appealed to his father to release him from his promise.

"Indeed not," said the father. "You are too young. It would be too expensive. Have nothing further to do with the Lewins."

If he studied before, his interest in books was now redoubled. Three years passed, and during that time he applied himself to a vast quantity of heavy reading in the classics, history, philosophy, political science, German, French, Italian. Then there were long discussions with his philosopher friends. He was developing rapidly into a thinker, the wound in his soul was healing. Then one day by chance he came upon Harriet, as she was waiting in her carriage. He talked to her for ten minutes, but the young philosopher was so confused and uneasy that he uttered scarcely one rational sentence.

"She looked lovely beyond expression," he wrote. "Her features still retained the same life and soul which once did so magnetize me; I never have seen it, and never shall see it, on any other face."

The vision of Harriet in the carriage would not leave his memory. He must bring the matter up to his father again. Wasn't he too old to be submitting to this tyranny? The father relented. The son might marry in two years, but there must be no visiting in the meantime. The lovers found some satisfaction in writing each other the minutest details of their unhappy lives, but they could not bear the agony of separation for the two years the elder Grote had stipulated. They eloped.

When the ceremony was over, they returned to their separate homes. After several weeks the groom summoned up enough courage to tell his father. The elder Grote forgave his twenty-six-year-old son and settled him in a house next to the bank so that the thought of it might never leave his mind. It was not a healthy place, and this may have been the reason why the first and only child lived but a week. The mother contracted childbed fever, which left permanent traces in her health.

About this time the idea of writing a history of Greece occupied his attention. His wife claimed credit for suggesting it to him. She said to him:

"You are always studying the ancient authors whenever you have a moment's leisure; now here would be a fine subject for you to treat. Suppose you try your hand."

Grote had a great sympathy for the Greek city states where democracy flourished, and he early defended it very capably against Mitford, a historian who had assailed Greek rule by the people with the evident purpose of furnishing a horrible example to those who were at the time agitating for the reform of the ballot, a question that was just coming to a head in England. Grote was

for representative government in England, where members were still elected to the House of Commons by an ancient system which granted representation to a cemetery, and denied it to large industrial cities. Grote, who had for years been discussing theories of government with his radical friends, and who felt that the democracy of Athens was an ideal, could not quietly observe this fight for more equal representation.

During the long period of his wife's convalescence after the birth of their son, he worked by her bedside, composing his first published work on Parliamentary Reform, in which he assailed the theory of class representation current in England. His sympathy with popular issues was more and more bringing him to the fore as a candidate for parliament. His wife was not adverse to this, but she felt that the *History of Greece* should first be completed. In her diary she wrote: "The History of Greece *must* be given to the public before he can embark in any active scheme of a political kind." Despite her italicized *must*, he stood for parliament, and was successful.

Immediately he distinguished himself by his speech on the ballot. Liberals hailed him as a new champion; his speech was given wide circulation. Twenty years after its delivery, Lord Brougham told Mrs. Grote that he had heard the great orators of the century, and he had made up his mind that the two best speeches he had ever heard in parliament were Macaulay's first speech on the copyright question and Grote's first speech on the ballot.

Grote was not a practical politician. He was too much of a philosopher, too much of an individualist. When he was returned to parliament for the last time,

he won by so narrow a margin that he decided not to run again. Besides it distressed him to think that his history had been neglected during those eight years. His scholarly studies had to be dropped for affairs at the bank or the business of parliament. The years he had spent in the House of Commons had ripened his genius. The political questions debated in the ancient assemblies had more meaning to him now. What he had written years before was put aside, and he began his history anew. His fresh plan was so elaborate and the project so absorbing that he decided to sever his connection with the bank to which he had given thirty years of his life.

Grote came to his new work with the enthusiasm of an amateur. Now he was free to devote himself to a task he had wanted to perform for the past score of years. To his new labor he brought the training of the successful man of business. An instance of this transfer of training was the regularity of his industry. As though he were a clerk in his bank, he sat down at his desk regularly each day and spent a definite number of hours at his work. There was no temperamental complaint from him that inspiration was lacking. He was at his desk to receive it if it came. His wife felt he was at his desk too much, and, in order to keep him from turning into a recluse, she constantly planned recreations for him.

Such industry quickly bore fruit. Three years after his retirement the first two volumes of his history appeared. In these the instincts of the banker were evident. He examined the credit basis of the great legends of Greece. Some scholars were of the opinion that the great Greek myths were a veil concealing events

that really occurred once upon a time. To Grote myth was a past that never was present. He tells the legends, but makes it clear that there is nothing worthy of credence before the date of the first Olympiad, 776 B.C. Later scholars have proved that this traditional date is unfounded in fact. Grote's acceptance of it is an instance of how a sceptic may in a careless moment lapse into belief.

With steady industry and a godlike calm he completed his elaborate plan. In the next ten years he produced ten volumes, bringing his series to a close with the generation taking its name from Alexander the Great — 300 B.C.

Nothing that had ever been done could at all approach the extent of this digest of Greek history. Professional scholars might well look with envy on this row of volumes and note that its author had never attended a university. But if they were jealous, they were likewise generous in giving him the recognition that was his due. When the work was nearly finished, Oxford made him a Doctor of Civil Law. Mrs. Grote described his feelings in these academic surroundings :

Grote, personally, was a *little* nervous on finding himself in the thick of the academic throng for the first time in his life ; all the circumstances of his own literary career having run in a channel so distinct from that in which college men travel, he felt like a stranger introduced into the privileged fraternity. But I am bound to add that he returned from Oxford full of grateful and complacent feelings ; the cordial welcome given to the non-academic scholar seemed to tell upon his mind, whilst his classic taste was moved to lively relish by the few sentences of elegant Latin addressed to him on his reception by Lord Derby, of which he expressed much admiration.

Surely any scholar would feel that his dreams were amply realized in such honors, and that he might sit back and gaze with satisfaction at what he had done. It was not so with Grote. After the history was finished and subsequent editions revised, he began his *Plato and Other Companions of Socrates*, which appeared in three volumes after nine years' work.

Honors now came thick upon him. Cambridge made him a Doctor of Laws and Letters. Although he had never been a student in college, he was elected to the presidency of University College. At seventy-five, two years before his death, Gladstone, himself an inspired amateur in the classics, offered him the title of peer, an honor he felt forced to decline. At his death he was buried in Westminster Abbey, beside that great historian of Rome's decline and fall, Edward Gibbon.

Mrs. Grote published an interesting biography of her husband, though she gave too much space to the chronicle of her illness, the trips she took in the interest of her health, the foul weather, and their perpetual moving from one house to another. As a personality, she has more color than her husband. He was the quiet thoughtful scholar, she his business manager. A sarcastic critic might refer to George Grote of the House of Commons as "the member for Mrs. Grote," and Sydney Smith, on seeing her with a rose turban on her head, might remark that he now understood the meaning of the word "grotesque," yet there is no doubt she was an ideal partner for "her historian," as she called her husband.

She felt it her duty to see that he did not overwork, and to this end she insisted on his taking recreation. With some difficulty she trained him to be a gracious

host; he even grew to enjoy whist. But she did more than keep him from nervous breakdowns. She discussed his books with him, found a publisher, read practically all the proofs of his history. Like most men who become great, George Grote had a helper who labored with him not for fame but for love.

XI
ENLIGHTENING THE DOCTOR
STEPHEN HALES

While we congratulate ourselves on having attained to an understanding of the principles of ventilation, on having abolished typhus fever from our hospitals, prisons and ships, on having devised apparatus for sustaining life in irrespirable and deadly atmospheres, let us never forget that the initial stages in the comprehension of these things were worked out not by any high-placed, well-paid, public official, but by a modest amateur, the scientifically minded, country clergyman, Stephen Hales.—*D. Fraser Harris.*

XI

ENLIGHTENING THE DOCTOR

STEPHEN HALES

IF we search for a layman with the proper credentials to make him an inspired doctor, we encounter difficulties. The reason for this is obvious. The ideal doctor knows a considerable number of fields; he is a composite of many professions. Moreover, at least in modern times, a man must be properly licensed before he is permitted to practice, for the sick show a strange prejudice in expecting a physician to do his preliminary cutting on cadavers before assailing the quick flesh. Although among medical doctors there are no inspired amateurs of sufficient stature to consort with these amateurs of other fields, still in the history of medicine there are men from other walks of life who have made contributions to the knowledge of the human body and the means of curing its ills. There is a well-known statement supporting this view in Oliver Wendell Holmes' essay *Scholastic and Bedside Teaching*:

Medicine . . . learned from a monk how to use antimony, from a Jesuit how to cure agues, from a friar how to cut for a stone, from a soldier how to treat gout, from a sailor how to keep off scurvy, from a postmaster how to sound the Eustachian tube, from a dairy-maid how to prevent small-pox, and from an old market-woman how to catch the itch-insect. It borrowed acupuncture and the moxa from the Japanese heather, and was taught the use of lobelia by the American savage.

Priestley created wonder in the minds of his parishioners

by visiting a brewery to determine the nature of the gas in the vats of fermenting beer, but this was in no way comparable to the various non-clerical interests in which the Reverend Stephen Hales indulged. These ranged all the way from hints to housewives on cooking to plans for ventilators of ships and prisons. As a youth his recreation had been the study of anatomy, chemistry and botany. After he left Cambridge and was made a perpetual curate of Teddington in 1708, at the age of thirty-one, he had that security of income and leisure for reflection which made it possible for him to continue his scientific hobbies.

There is no evidence to prove that Parson Hales was any more neglectful in ministering to his flock than other clergymen of that day. In fact, it would seem that he performed his duties very exactly. Certainly he was a little stricter with his parishioners than was customary in his church in those days, for he made women do public penance.

The poet Pope, who lived near him and who knew him personally, wrote of "plain parson Hale" in one of his Epistles, paying tribute to "his exemplary life and pastoral charity as a parish priest." And Alexander Pope was the last man in the world to praise any man who was undeserving, least of all a minister. As it was, the poet found reason to censure him for his experiments on living animals. "How do we know," the poet asked sarcastically, "that we have a right to kill creatures that we are so little above as dogs, for our curiosity, or even for some use to us?" Apparently the march of progress in this instance was being led by a churchman.

Hales is remembered for his observations on blood pressure, the first study that was ever made on this

popular subject of conversation. His rather crude experiment was performed on a mare. The animal was tied down, the artery in its left thigh opened and tied off. Into this artery he inserted a brass pipe to which a second brass pipe was fastened, which in turn was joined to a glass tube nearly nine feet high. When the binding of the artery was loosened, he observed that the blood rose eight feet and three inches above the left ventricle of the heart of the animal. Here is the fountain head of that bit of science which has disturbed you—or will disturb you—when your physician tells you that your blood pressure is either too high or too low.

While he did not hesitate to practise vivisection on animals, he was profoundly interested in saving man the pain of the surgeon's knife. Those who have read the secret diary of Samuel Pepys will remember something of the operation which men suffered when surgeons of his day cut for the stone. The coming of the doctor with his retinue of stalwart helpers, whose duty it was to hold the patient still while the cutting was being done, was like the descent of an armed band upon the home of a defenseless peasant. There were no anesthetics then and the pain suffered was intense. In those days of imperfect diagnosis, it sometimes happened that the cutting failed to reveal a stone. In such cases the physician might hand the patient one from the supply in his pocket, kept for just such emergencies.

The Reverend Hales applied himself to the study of solvents for bladder and kidney stones. The Royal Society thought so well of the paper which he presented on the subject that its members awarded him the Copley Medal, the most noted distinction which it was within

its power to confer. Some of the learned gentlemen of the society knew from experience the suffering connected with cutting for the stone; those who had not suffered the operation probably feared it as much as Pepys did. To a man they were anxious to reward any scientist who made any progress in lessening the necessity of the knife.

No surer evidence of the integrity of the medical fraternity can be given than its interest in preventive medicine, whereby doctors deliberately strive to keep people from incurring infection and illness. It is in this phase of medicine that Reverend Hales was particularly interested; for his work on ventilation, in which he proved the value and necessity of fresh air, he takes a place as one of the great sanitarians of all time.

People of Hales' day had little knowledge of the value of fresh air. Many houses had been constructed with as few windows as possible. One reason for this was that a man's tax depended on the number of windows in the home. The ever unpopular tax collector had fallen into special odium in England because of the hearth or chimney tax, whereby property value was judged by the number of grates in the house. During the reign of William III, this tax was supplanted by one which could be computed without the appraiser's invading private dwellings. The bigger a house, the more windows it had. Therefore the rental value of a home was determined by the number of its windows and openings. People are as clever in dodging taxes as authorities are in inventing them, but in this case the means they took of avoiding the tax, that of having few or no windows, was a most unhealthy artifice. Men began to live in dark, damp, foul-smelling chambers. Particularly

foul was the air in prisons where there were other reasons for not having many windows.

To be sentenced to a jail in those days was not an opportunity for a man to get caught up in his reading but frequently a sentence to a death, almost certainly resulting from jail fever. When several notables died at the trials held under these conditions, the matter of remedying this situation was taken up by a committee of the Royal Society, which handed the problem over to Hales, the logical man to consider it, for he had for some time studied the importance of fresh air and the harmful effects of breathing foul air over and over again.

His theories were tested at Newgate Prison where his invention, a windmill, operating bellows by which foul air was drawn from the cells, was mounted on top of the roof. The beneficial effects were immediate, the death rate dropping over fifty per cent. After his apparatus was installed in Savoy prison, where the average death rate had been about seventy-five a year, only four prisoners died of jail fever in the ensuing three years.

Hales was also interested in combating that scourge of life at sea, the scurvy. This began with bleeding gums, after which the teeth fell out, the skin became blotched, the ankles and wrists swelled. The sufferer really rotted to death. In spite of his reputation, certain naval officers treated him with scant courtesy when, at the request of enlightened authorities, he presented himself to help them solve their problems. But Hales convinced seamen that they could not sleep in crowded, ill-ventilated quarters and remain in good health. One captain of the period publicly expressed his enthusiasm for the ventilators in this way :

“Two hundred men aboard for a year, pressed from

gaols, with distemper all landed well in Georgia. This is what I believe but few transports or any other ships can brag of nor did I ever meet the like good luck before which, next to Providence, I impute to the benefit received by the ventilators."

Of course the credit for curing the scurvy does not go to Hales, though his emphasis on fresh air as essential to the health of seamen was a contributing factor. As far back as 1617, a naval physician had pointed out the value of lemon juice in preventing this disease, but it was really left for Captain Cook to demonstrate to physicians the value of these forgotten suggestions.

Ministers have often been criticized for obstructing the path of science, but this charge cannot be levelled at Stephen Hales, for he was far ahead of his day in matters scientific. Anything touching life was of absorbing interest to him. The process of growth in plants fascinated him, and his studies in this field were so penetrating that he has been called the founder of experimental, botanical physiology. Indeed, some few years ago, the American Society of Plant Physiologists honored his name by creating the Stephen Hales Prize in Plant Physiology. So great was his interest in animal life that he practised vivisection in spite of criticism. In the case of human life, his profession demanded that he interest himself in the life of the spirit, but he seems to have saved his genuine enthusiasm not for matters touching the supernatural life but rather the natural life of man.

XII

THE LENS-GRINDING PHILOSOPHER *BENEDICT DE SPINOZA*

“He developed heterodox religious opinions. which led to his excommunication by the Amsterdam rabbinate in 1656. Therefore he settled down to lead the picturesque but difficult life of a philosophic saint, grinding lenses for a living and devoting the leisure of his short life to the composition of an *Ethics* ‘demonstrated in the manner of geometry.’” — *Benjamin Ginzburg*.

XII

THE LENS-GRINDING PHILOSOPHER

BENEDICT DE SPINOZA

IN A very broad sense every sane man may be said to be a philosopher. He has some principles by which he guides his course through life's arguments and perplexities. Generally his ideas are not original. Often they spring from his allegiance to some organization sponsoring mass thinking. When such a man discusses the universe, we say that he is philosophizing. He is speaking in the manner of a lover of wisdom, though in reality his statements may be far from true.

But in a technical sense a philosopher is a prober of causes who attempts to solve the riddle of this painful world, the power or law that sustains it, and the purpose of it all. He is interested in man's nature, his place in the universe, his duties and obligations. These questions offer difficulties to the philosopher. The theologian will not confess himself at sea in these issues, for he maintains that these courses have long ago been charted by revelation.

Benedict de Spinoza was an amateur philosopher. He had no academic background; indeed, it would have been quite impossible for him to gain a university degree in the middle of the seventeenth century because universities were closed to Jews. He never held a chair of philosophy, though he was offered the opportunity to teach that subject at the University of Heidelberg. He never gave any lectures, yet his ideas have been a potent

force in shaping the thought of many lecturers since his time.

Though Spinoza could furnish no university credentials, he was not on that account untutored. His father had sent him to the synagogue school when he was seven, and this instruction, consuming a generous portion of the day, continued until he reached the age of twelve. In this period he completed the reading of the Old Testament in Hebrew and was introduced to Hebrew grammar and the Talmud.

Spinoza's father, though constantly plagued with ill fortune, was able to keep his bright son in school. At thirteen he was sent to the Tree of Life Academy. Here Baruch—later he used the Latin equivalent, *Benedictus*—studied the sacred text and then the commentary, and was a joy to his father and the elders, who took it for granted that he would grow up to be an illustrious rabbi in Israel. But there were difficulties in the sacred writings which, he felt, could not be solved. Other scholars before him had seen many intellectual objections. He read their guides for the perplexed, but the perplexities still remained. He reverently pointed out his difficulties to the rabbis; but to the young thinker the replies were not answers.

It is often difficult to trace the seeds that later develop into apostasy. Sometimes it is difficult for the one who has had the experience of a change of faith to trace its origin and growth for his own satisfaction. When one considers the sheltered life led by young Baruch, his aloofness from the gentiles in Amsterdam, and the restricted range of subjects in the curriculum of the academy, his development is as difficult to explain as that of a botanical sport which suddenly appears among

a hundred thousand flowers, all of the same variety with the exception of one which possesses an absolutely different characteristic.

There were many things to keep Baruch from deserting the ranks of Israel. He knew that he would never be welcomed wholeheartedly by gentiles. Then, too, he would always be regarded as vile by those whom he had deserted. He could hardly forget the penance—he was eight years old at the time—that had been meted out to Uriel Acosta when the latter sought re-admission to the synagogue after his desertion.

That unfortunate man had bared his back for the lash; afterward, as the righteous left the temple, he lay prostrate at the portal to be tramped under foot by his more orthodox brethren. Wild with pain, he armed himself to kill those who had humiliated him. But he was unskillful in the use of weapons, and when his aim missed, he turned his gun on himself. All these considerations must have flooded Baruch's mind, as he contemplated surrendering the faith for which his fathers had suffered for centuries. He shrank from being a stumbling-block to the piety of others about him, but everything within him rebelled at living this life of allegiance to ideas in which he did not believe.

Baruch's interest in the ancients had led him to take Latin lessons from a director of a private school who had once been a Jesuit. There was some adverse criticism from pious Jews in Amsterdam when this became known. The misgivings of the children of Israel were not unfounded, for Baruch's new professor had been through a religious crisis in his own life and was interested in disseminating the ideas derived from his meditations. It is not impossible that it was he who opened

up the sealed compartments of Baruch's mind by telling him, between declensions and conjugations, of the "new learning."

The Jews of Amsterdam were shocked when they learned that this promising youth, who had practically lived in the synagogue, had taken up his residence at the home of his new teacher. The rabbis had disapproved in the first place when he had enrolled to study Latin. Gentile learning was vain. Hadn't one rabbi done penance forty days and forty nights to purge his mind after learning this language? Indeed there had been rabbis who had studied Latin, but to live under the same roof with the gentile teacher. . . Yet the leaders of the synagogue treated their erring brother with great consideration. They were aware of the capability of this young man of twenty-four. They knew that many seemingly conscientious objectors can often be made to see, by the light of the glint of money, a point of view hitherto unacceptable.

Spinoza was told that if he returned to the performance of his religious duties, he would be granted a stipend of about four hundred dollars a year. He would eventually be admitted to the rabbinate and become a leader in Israel. But Spinoza was not to be won so easily from his conclusions. The rabbis shook their heads gravely, remembering certain temptations that had been in their own minds, and mourned for youth's impetuosity. Spinoza made it clear that he had no price and thereupon returned to live under the roof of the gentile. The rabbis did not act hastily, but it was clear to them that they had no choice but to excommunicate this rash youth, if only to discourage others who might be contemplating a similar career of sin.

About this time an unsuccessful attempt was made on his life, and he left the city for a village just outside of Amsterdam. Then his excommunication was made public. The rabbis declared that they had for a long time been aware of the frightful heresies which he not only professed but taught others, that he had been accused and convicted in their presence. "Therefore," they wrote, "we excommunicate, expel, curse, and damn Baruch de Espinoza." The decree angered Spinoza, and he futilely answered the condemnation.

The young heretic felt his isolation very keenly when he found himself cut off from association with his kinsmen. He was not yet so detached as to be indifferent to the scorn in which he was held by the Jews about him. His former friends were now forbidden to communicate in any way with him, to show him any kindness, to stay under the same roof with him or approach him within a specified distance. Those who would keep their souls clean must avoid him as if he were a leper.

Before his break with the synagogue, Baruch had not been obliged to worry about his means of subsistence, but now he must earn his bread. The student looked out upon an unfriendly world and wondered how he could wrest from it the bare essentials which even the philosophers must have. After a few unhappy weeks at the village outside of Amsterdam, he returned to the city. The blood of merchants was in him, and he considered for a time the idea of devoting himself to a business career. In the preface to the *Improvement of the Understanding* he relates his temptation to "take the cash and let the credit go," but after a sharp struggle he reasoned that if he were to obtain happiness, it would

be more certainly reached through indifference to the accumulation of external goods.

Once back in the city, he began to earn his living by grinding lenses. This was a rather unfortunate choice of occupation, for he was tubercular, as his mother had been, and this work kept him in his room, away from the fresh air and sunlight, breathing glass-dust into his lungs. He kept up the trade, however, for a score of years and died with his polishing tools in hand.

It was quite natural that he should become the high priest of a group of liberal-minded merchants in Amsterdam. These men were amateur theologians and philosophers who loved to discuss high themes. Baruch was welcome in their circle. He had studied the Scriptures in a most thorough fashion and had read the commentaries. He could shed light when light was needed. Moreover the young Jew inspired their respect, for he had had the courage to suffer for his convictions. They had the pleasure of his company for four years, and then he decided to move to Rynsburg, forty miles away.

The motive of his leaving is uncertain. It may be that the philosopher could not find the seclusion necessary for the work he wished to do. Then, too, he may have been taunted by his former co-religionists, and this explanation gains some value when we consider that the town to which he went was the center of the Collegiants, a sect of few dogmas and abundant tolerance, welcoming members of any creed. Their ministers were in a sense amateurs, being endowed, in the opinion of the faithful, with no greater power than any one of the brethren. This breadth of tolerance must have pleased a man whose sensitive soul had suffered so many sharp thrusts from the Jews of Amsterdam.

It may be that he found the years of his life, which he knew would be brief, slipping away from him without that work done which his nature urged him to perform. When he attained the seclusion necessary for sustained thinking on profound subjects, he immediately began writing *A Short Treatise on God, Man, and His Well-being*, which was followed by his unfinished essay *On the Improvement of the Understanding*. These writings were not intended for publication but for the private inspiration of his Amsterdam disciples who circulated them in manuscript.

Students at the University of Leyden, not far from Spinoza's home, soon discovered him. In their enthusiasm for speculation they made their way to Rynsburg to discuss philosophy with him. They, too, were interested in the newer thinking typified by Descartes, and Spinoza was not unwilling to spread the new gospel. His fame went abroad. The solitude he had hoped for in Rynsburg was vanishing. His leisure was further limited by the fact that he had undertaken the instruction of a not too intelligent student, who was to live with him.

Spinoza had begun the composition of *The Ethics*, but he could not work with this pupil in the house. To improve the student's mind he dictated to him a section of Descartes' *Principles of Philosophy* in the form of geometrical propositions. Later, while on a visit to Amsterdam, his friends urged him to sit down and finish the work for publication. Since he was not in entire agreement with Descartes, he had some scruples about it at first but in the end consented. The book brought him immediate recognition.

In the hope of gaining protection against attacks from

the religious, he moved closed to The Hague. Here he took up his tools and began to grind his lenses by day ; at night, from ten o'clock far into the morning, he labored over his *Ethics*.

About this time Holland chose to forget the service of its Grand Pensionary, Jan de Witt. At the first sign of military reverses, a fickle populace began to cry out for the return of the House of Orange. Calvinist clergymen were at pains to point out the godless men with whom De Witt associated, and, of course, among this number Spinoza was included. The latter saw that much of the trouble then disturbing society was due to a religious intolerance that refused dissenting minds the right to express their views freely.

Feeling that he might be able to effect something in the cause of freedom by publishing some rational ideas on the Scriptures, government, and liberty of thought, he interrupted his *Ethics* to write the *Short Treatise on Politics and Religion*. The work was published anonymously and has often been printed with a false title to escape discovery. There is a copy extant with the title, *The Art of Sailing Against the Wind*. When this tract, regarded as diabolical in its day, was finished, he again turned to the labor of writing his *Ethics*.

And so he continued to toil unceasingly at polishing his lenses and his ethical propositions. So intensely did he apply himself that often he did not leave his room for days at a time. Finally, his masterpiece, *The Ethics*, a closely connected structure of cold geometrical propositions was finished, and so was his life. With his manuscript he set out for his friends in Amsterdam. But enemies heard that a new book of his was forthcoming, and they raised such a storm of protest that he thought

it unwise to have it printed then and returned with it to The Hague. His life work was over. He could drive his frail body no farther, but he worked to the very end.

In 1677, in his forty-fifth year, after giving instructions about his manuscripts, he died resignedly and peacefully, as he had lived. Many a prayer of thanksgiving was uttered by the devout at his passing, and the opinion of the century that succeeded his death is pretty well summed up in the words of a preacher who passed his grave and said to his companion, "There is Spinoza's grave; spit on it."

It is not difficult to understand why a minister would suggest dishonoring the grave of Spinoza, for his explanations of the Bible had opposed the necessity of revelation, miracles and prophecies. In his mind much of the miraculous in the Scriptures had resulted from a literal interpretation of its poetry. Moreover he did not accept the Christian dualism of spirit and matter; there was no spirit but only matter.

On these grounds many proceed to atheism, but Spinoza refused to be classed as an atheist. To him everything was God. Man not only lived and moved and had his being in God, but he was a part of God or Nature—terms which were identical to him. Man, therefore, had within him no spiritual principle independently surviving in a future life. This was not a roseate prospect for those who believed that the virtuous would be decorated in the next world and the wicked burned. He scorned the idea of doing good for a prize and avoiding evil to escape punishment.

Moreover man could not merit reward or censure because he was not free. His actions are predetermined by causes over which he has no control. If one knew

all the causes, remote and proximate, of an action, it would be apparent that he was determined to this action. So the delusion of freedom rises out of man's desires and volitions. If a stone cast into the air were suddenly given consciousness and found itself moving, it would conclude that its motion was the result of its own power. Man, too, is impelled by forces of whose nature he is ignorant and, therefore, concludes that he is directing his own course.

Hearing this, the orthodox Christian would assert that there would be small reason for living if this were true. Spinoza replied that, because one was not destined to live forever, he saw no reason why he should not enjoy as much of life as lay before him. The sun does not shine always; yet we enjoy it when it does. He held that there was no definite aim or purpose in man's existence. Man would naturally pursue happiness, which consists in the intellectual, not the sentimental love of God. This was equivalent to the understanding of nature and really furnished man with science as a pursuit that would bring happiness. Man's greatest good, then, lay in the realization of the relation of his mind to God or Nature. If one is in tune with the universe and views all things from the aspect of eternity, he will enjoy the happiness that is proper to his nature.

The philosophy of materialism may produce the selfish, anti-social criminal, but there was nothing base in Spinoza. Few lives have been holier than his. Indeed many a saint has ranked below him in self-restraint. He chose a life of self-denial deliberately, not as a means of expiating the waywardness of his youth, as did Augustine and Ignatius. As a young man, Baruch was not guilty of those follies which drive men in their old age

to sackcloth and ashes. His self-control has awakened the admiration of many who will not accept a single point of his philosophy. There are traces of impatience in his letters, but the provocation was ample.

Once he became excessively angry. Jan de Witt had gone to see his brother in prison, and both were brutally murdered by the mob. When Spinoza heard of this, he was determined to face the rabble and speak his indignation. His landlord asked him what he would say. He would paint a placard on which he would write the words, "Base Barbarians," and wave this before them. The landlord simply turned the key in the door of his tenant's room. The philosopher quickly regained his composure and uttered words of resignation that remind one of Christ's prayer on the cross for the forgiveness of those who "know not what they do."

Spinoza was an ascetic in his own life, but he had not the fanaticism of those who would maintain that simple pleasures, indulged in solely for enjoyment, are unlawful for the man who would be virtuous. He believed that a reasonable man should enjoy pleasure within bounds, that no indulgence should be carried to the point of excess, since this would be unreasonable and ultimately lead to unhappiness. He wrote in *The Ethics*:

I say it is the part of a wise man to refresh and recreate himself with moderate and pleasant food and drink, and also with perfumes, with the soft beauty of growing plants, with dress, with music, with many sports, with theatres, and the like, such as every man may make use of without injury to his neighbor.

Spinoza did not have the means to enjoy all these things, but he generously conceded their use to those

who could afford them. He believed that the best things in life were free. One of his early biographers estimated that during one month he had allowed himself only a pint of wine. Sometimes, when tired, he would smoke a pipeful of tobacco with his landlord.

Considering the intolerance of his age and the groups of mass thinkers he offended by his teachings, he fared very fortunately. Many a man has lost his life for espousing doctrines such as those Spinoza advanced, but by some miracle he escaped physical punishment. He did not die by the violence of a mob, nor were fagots put under him that his life might be taken without the shedding of blood, nor was he ever sent to prison. It is a marvel that this outspoken champion of free thought died naturally. Perhaps we may attribute his escape to the quiet virtue of his life, which must have impressed even zealots who would have gladly crucified an infidel in the thought that they were offering God a pleasing sacrifice.

XIII

TODAY'S AMATEURS

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THE interests of these inspired amateurs have ranged from gases to philosophy, but not every study between these two terminals is represented in these pages. Still there can be little doubt that every field of study would reveal its inspired amateur upon investigation.

No mention has been made of men who pursued one of the fine arts with success, though they were trained in other fields. Examples of these are plentiful. Consider, for example, how many physicians have devoted their talents to literature: Chekhov, Rabelais, Schiller, Oliver Wendell Holmes, Sir Arthur Conan Doyle, Sir Robert Bridges, and Sir Thomas Browne. Nor has mention been made of inventors, men of great resolution and ability, who have perfected some device or machine in a field entirely foreign to their daily work. Here, too, the doctors have their representatives in a most unexpected field. Gatling, who invented the gun named after him, and Guillotin, famed for reviving the guillotine, were both physicians. Other professions could offer their candidates, too. But the number of amateur inventors is so great that a list of these would hardly create wonder.

The selections of amateurs have been made from scientists and philosophers who dealt with studies rather than devices, with the theoretical rather than the practical. Thus in the field of botany Mendel finds a place instead of Burbank. The latter was practical and literally donated a great number of new varieties of fruits, berries,

flowers and trees to man. Yet he had not the scientific temper, being interested in practical matters rather than in theory.

Though our selections have been made from the dead, there are many inspired amateurs abroad today. This is especially true in the arts. The radio has devoted much attention to the work of amateur musicians, and this has brought to the public attention a great number of finished performers. The depression has promoted this, for it gave people the leisure to pursue some such avocation. Yet distinction here is much easier of attainment than it is in the realm of science or philosophy.

The question may be raised whether the professionally untrained man has a chance in our time of accomplishing anything noteworthy in scientific studies. People are always ready to admit that in former generations the opportunities of making an original contribution were more numerous than they are in the present. To a great extent this is true, for the development of necessary equipment in certain fields of science makes it rather improbable that the "private gentleman" will engage in any work so costly, and it is still less probable that he will light upon anything that has escaped the professional eye, if he applies himself to these problems.

It must be admitted that it is much more difficult to be an inspired amateur astronomer in our day than it was in the days of Herschel. The heavens have been swept too frequently to admit of the probability of an amateur's discovering what professional astronomers have missed; yet only recently two comets have been discovered by amateurs. In the field of chemistry, so thoroughly combed each year for dissertations by hundreds

of students and by the host pursuing research for private ends or corporate interests, there is little chance that an amateur will ever advance the frontiers of knowledge. The same condition obtains in physics.

Yet there is danger in such an attitude. If one argues by analogy, he may maintain that the professionals are too many laps ahead of the amateur in the race of discovery. Such comparisons are more clever than cogent. The same statements were made by professionals of a former age when they addressed the amateur. The feeling of the guild toward the intruder has never been cordial. Relatively considered, the amateurs whom we have discussed were impeded by difficulties just as serious as those that face the modern amateur. In spite of all the equipment and preliminary knowledge necessary, tomorrow's possibilities of success may equal yesterday's.

We are inclined to look upon the discoveries of a former age as primitive; we forget that what every schoolboy now knows was once a puzzle to profound thinkers. If a route has been discovered, it is easy to point it out. Perhaps those principles that have been laid bare in our own time have required no more native genius or intense concentration than the earlier elementary conclusions. It is characteristic of each generation to place itself on an intellectual pinnacle and maintain that succeeding ages will never mount higher.

We are inclined to smile at the theories advanced in science a century ago, forgetting all the while that the generations to come may smile, as they read some of our accepted scientific theories. We are greatly amused as we turn the pages of magazines showing the fashions of only a generation ago; in later ages some historian of

the curious and the naïve may include our theories in his narrative.

Even in those fields, then, which have been so thoroughly investigated, it is not safe to admit that the full limit of development has been reached. The great scientific advances made thus far in the twentieth century should teach us caution in this matter. It may well be that science is still in the larva stage and has not yet taken to wing. We may be at the threshold of unimagined discoveries. This is at least a more enlightened policy than that short-sighted attitude of one legislator, living in the middle of the last century, who maintained that, since all the fundamental inventions were discovered, there was no longer any need of keeping the patent office open. Amateurs of brilliant intelligence may yet make valuable contributions to the history of man's struggle up from superstition, ignorance, and barbarism.

While it is true that certain fields of science have been carefully typed and filed, there are other sections of knowledge which offer unbounded possibilities. All the fossils in the earth are certainly not studied and catalogued. There are problems in geology the solution of which may be found in some amateur's garden. The microscope, which Leeuwenhoek loved so much, will still continue its book of revelation. Zoologists know that there are many thousands of animals, from the lowest to the highest orders, which await study and classification.

There are buried civilizations awaiting the shovel of the archaeologist, who may produce evidence completely altering our positive interpretations of ancient civilizations. There are still many mysterious ills which

afflict the human body, many of its functions are imperfectly understood, many remedies yet to be discovered. Some clear-eyed amateur may look into the face of one of these enigmas and see what others have not seen, even though they have gazed a lifetime.

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